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SCHEFFERVILLE TRANSECT SURFACE ROUGHNESS DATA ANALYSIS (U)

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J.J. Fitzgerald

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ABSTRACT

There are two transects, Schefferville and Petawawa, in Canada which have been used to generate terrain surface roughness data for input into mathematical models such as the NATO Reference Mobility Model.

The Schefferville data was collected during the summer of 1987 and this report deals with its analysis.

The surface of this transect is predominantly a glacial moraine deposit with outcropping bedrock ridges.

The analysis showed that the terrain at Schefferville was generally much rougher than Petawawa and that within the transect five separate surface roughness class types exist as opposed to three at Petawawa.

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ACKNOWLEDGEMENTS

The author wishes to extend his appreciation to Andrew Nadeau who assisted in the data collection at Schefferville and to the staff of the McGill Subarctic Research Laboratory who provided information relating the the Schefferville Transect.

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1.0 INTRODUCTION

Shortly after the vehicle mobility research program moved to DRES in the late 1970's, a project was initiated to establish data bases of terrain properties affecting mobility which were representative of Canadian off-road conditions. These data bases would, upon completion, serve as input to the NATO Reference Mobility Model (NRMM). To fill this requirement two Canadian transects were chosen, one near Schefferville in northern Quebec, to represent northern conditions, and another at CFB Petawawa, to represent more southerly conditions. Collection of the data was largely contracted to McGill University.

The Schefferville transect was defined in 1981. The site was primarily selected to represent northern conditions because a large amount of data had already been assembled due to numerous projects which were ongoing at the McGill Subarctic Research Station located in Schefferville.

Independent field studies were carried out by the McGill re-

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search team during the winters of 1980 through to 1983 and during the summer of 1982.

The field work consisted of microrelief survey, soil strength measurements, vegetation sampling, and other observations required for input into the NRMM. Upon completion of the McGill team's work [Parry et al, 1985], the only terrain parameter remaining to be measured was surface roughness. Roughness data for the Schefferville transect was collected by a small team from DRES during the summer of 1987. The purpose of this report is to present the techniques used and the results obtained.

2.0 SITE LOCATION

The Schefferville Mobility Transect (SMT) is located on the Labrador Trough 15 km northeast of Schefferville. The transect is 15 km in length by 6 km in width. It is situated northeast-southwest from Elross Lake in the west to the fringe of Lac La Miltière in the east. Figure 1, Schefferville Mobility Transect, illustrates the boundaries of this transect as plotted on segments of the Elross Lake and Lac Knob 1:50,000 scale National Topographic Series (NTS) map sheets.

3.0 PHYSIOGRAPHY

The physiographic divisions of the Canadian Shield has the SMT situated in the Labrador Hills. This area is designated as being a sub-arctic zone in transition between boreal forest and tundra.

The predominant physiographic features of this transect are the tundra-covered ridges, the most recognizable being Irony Mountain (el. 840 metres above sea level (m.a.s.l.)) which borders the southwestern boundary. Within the southwestern part of the transect these ridges are generally either exposed frost shattered rock outcrops or crests covered with a thin veneer of moraine deposits. In addition, the ridges are often separated by small valleys that have deeper moraine deposits. These deposits have resulted in the ponding of many small lakes such as Elross, Triangle and Pinette Lakes.

The northeastern part of the transect is characterized by lower relief and thicker moraine deposits. The moraines are generally in the form of rolling hills with a thick cover of lichen. Below 600 m no tundra occurs and development of closed and open lichen woodland is predominant on slopes. The bottoms of valleys and depressions are covered in muskeg. Figure 2, "Transect Cross-Section", illustrates a typical profile of the transect with the vegetative changes in elevation.

4.0 GEOMORPHIC UNITS

Within the transect seven geomorphic units were identified that could be used to separate individual surface roughness classes. These units are Muskeg, Frost Fractured Bedrock, Scree Slopes, Moraine Ridges, Vegetated Moraine Ridges, Till Plain and Vegetated Ground Moraine. Figure 3, "Geomorphic Units", illustrates the location of these units.

5.0 DATA ANALYSIS

The analysis of the Schefferville data will follow a similar format to that taken for the Petawawa Transect (Reference 1).

The data analysis determines which surface roughness (rms) class should be applied to a Geomorphic Unit. The assignment of surface roughness classes is based upon the NRMM specification for surface roughness. Within the NRMM, there are nine classes of surface roughness. These classes are listed as follows:

<u>Class No.</u>	<u>RMS Range</u>
1	0 - 1.27 cm (0 - 0.5 in)
2	1.28 - 3.81 cm (0.6 - 1.5 in)
3	3.82 - 6.35 cm (1.6 - 2.5 in)
4	6.36 - 8.89 cm (2.6 - 3.5 in)
5	8.90 - 11.43 cm (3.6 - 4.5 in)
6	11.44 - 13.97 cm (4.6 - 5.5 in)
7	13.98 - 16.51 cm (5.6 - 6.5 in)
8	16.52 - 19.05 cm (6.6 - 7.5 in)
9	19.06 (7.5 in) and larger.

The first step in the analysis of data takes place prior to field collection of data. This step involves becoming familiar with the transect and begin formulating a general impression of the geomorphic units that outline the boundaries for the surface roughness classes. To accomplish this a preliminary geomorphological map is made using aerial photographs and airphoto interpretation techniques. Once this map is made field collection of data is performed by producing

random survey profiles that determine a surface roughness number for a given profile in each geomorphic unit. The number of profiles taken in a geomorphic unit in order to achieve a good statistical representation of the unit is solely dependent on its size, and whether or not it is accessible. If a unit is not accessible either because of dense vegetation or due to the personal danger involved in getting a profile of the unit, a surface roughness class is assigned based on classes found in similar areas. If a unit has been identified and cannot be measured because of one of the above reasons and there are no similar cases on which to base a good estimate of the surface roughness class, a lowest conceivable surface roughness class is assigned with the expectation that either slopes, vegetation or obstacles will be the chief determinant of trafficability. The location of the random profiles is shown in Figure 1. Annex A provides both a plot of the profiles prior to detrending and after detrending has occurred and a calculation of surface roughness (rms). Detrending is essentially the removal of slope. The algorithm used is based on a report (N.R. Murphy 1984] which uses a 60' wavelength. It should be mentioned that where multiple changes of slope occur the detrending accuracy of the algorithm decreases and consequently the rms values tend to be slightly higher than expected. A second problem is that when profiling is occurring on Fractured Bedrock or in dense brush it is hard to maintain a 250 mm spacing between measured points. In reviewing the data the average distance between measured points is closer to 300 mm. Thus the calculation of the rms is made using 300 mm spacing to accurately reflect this change in spacing. Table 1 provides a breakdown of what profiles were obtained in each geomorphic unit. The table illustrates that no profiles were obtained within the unit designated as Vegetated Ground Moraine. The reason for this is that the areas are essentially a closed lichen woodland. This terrain type has a very high density of trees which restrict all profiling efforts by limiting visibility in any direction. The limitation

explains why very few profiles were obtained east of Annabel Road in the zone that is identified as Vegetated Moraine Ridges. Table 2 shows the profiles and their corresponding rms value and class within a given geomorphic unit. The two largest geomorphic units, Vegetated Moraine Ridges and Moraine Ridges fall within the NRMM class 3 surface roughness category. The primary difference between these two categories is that one area is defined as being vegetated (tree covered) with a thick lichen mat while the other, due to its elevation, only has a thick lichen cover. Although both are identified as NRMM class 3 the vegetated zone would impose considerably more problems to trafficability. In particular the thick lichen mat, when wet, becomes extremely slippery and makes traversing up or down slope impossible as both traction and steering are reduced considerably. The deviations found in the rms values for Moraine Ridges can be primarily accounted for by either an increase or decrease in boulders found at the surface. As moraines are essentially glacial deposits without much alluvial sorting the matrix of the material can be variable. The elevation of the exposed material is important. On ridges above 600 m no vegetation is found and frost sorting of boulders occurs. The increase in boulders due to frost sorting can cause an increase in the measured rms values. In contrast, rms value fluctuations in a vegetated moraine ridge zone can principally be attributed to fallen vegetation in the form of small tree trunks. The sorting of boulders by frost heave is not obvious.

The minor extent of the differences in the rms values between Vegetated Moraine Ridges and Moraine Ridges does not warrant their class separation. However because of the effect of lichen and dwarf vegetation on mobility a distinction should be made for their effects on trafficability. As previously mentioned the unit identified as Ground Moraine was covered in dense forest. However due to its simi-

larity to the two previous units and to satisfy the requirement that a NRMM class be assigned for purposes of the operation of NRMM, a class 3 designation would appear appropriate. It should be noted that in any real mobility scenario through this type of environment the surface roughness class designation would be irrelevant as traffic through such an area would modify the surface by knocking over trees which consequently become longitudinal obstacles. The smoothest geomorphic unit is the Till Plain and it has a NRMM class 2 surface roughness. The unit is principally above the elevation at which an abundance of trees is found. The surface of the unit has characteristically only a thin lichen cover. The only real obstacle to mobility in this unit is the occasional glacial erratic which can be negotiated. The lichen cover, when wet, may also pose a problem to traction. However, due to its thin nature and the fact that the cover is broken thus exposing a firm substrate, this obstacle is considered less of a hindrance to traction than if it were at a lower elevation where lichen would be considerable thicker.

In contrast to the Till Plain the roughest geomorphic unit is the Frost Fractured Bedrock. The latter in most cases should be considered more an obstacle than a rough surface. The nature of this terrain made profiling very difficult and when wet was considered even dangerous. The rocks had a thin lichen veneer which made walking treacherous. For this reason very few profiles were obtained. Photographs in Figures 5 and 6 illustrate the nature of this particular geomorphic unit. Figure 5 shows an Ironstone Bedrock Outcrop which was deduced to be of NRMM Class 8 while the terrain shown in Figure 6, Frost Schattered Ridge Outcrop, was considered too hazardous to attempt profiling.

The next geomorphic unit, Scree Slopes, may be considered to be

in the same category as the previous unit. Although only one profile was obtained, the unit was of an unusual character. It was on the lowest part of a slope and possessed a vegetative cover. The fact that it is vegetated was a good indication that it was no longer developing but had acquired a degree of stability. The measured value for this slope would be higher were it not vegetated, as the occurrence of vegetation (lichen mat) tends to smooth the surface. Throughout the transect the stabilization of Scree Slopes was rare. The measured rms of 3 does not compare to the higher values of 4,5,6 and 8, found for frost fractured bedrock which is similar in structure to the scree slope unit except for the omission of a steep slope. Hence, a realistic designation of Scree Slopes would place them in the NRMM Class 5 range. The raising of the rms value by two units was done to more accurately reflect the higher rms values found in frost fractured bedrock and to account for any smoothing of the rms factor due to the lichen mat cover. Given the problems of mobility on these slopes due to the looseness of rocks and the absence of vegetation, the high NRMM class designation is justifiable. The photo in Figure 7, Ridge and Scree Slopes, illustrates a typical Scree Slope within the transect. The problems of obtaining a meaningful surface roughness measurement was not restricted to Frost Fractured Bedrock and Scree Slopes alone, but also to Muskeg.

Muskeg within the transect was found to be waterlogged giving the unit a spongy surface. One profile was obtained at the periphery of a Muskeg patch where the water was better drained. The overall view of Muskeg within the transect is that due to the spongy nature of the surface, rms values were meaningless. However, because the NRMM requires a surface roughness value for its operation, the lowest NRMM class was assigned so that other terrain parameters such as surface strength could be better employed for the calculation of trafficability. The photo in Figure 8 illustrates a typical Muskeg site. The

NRMM surface roughness classes which have been discussed are shown in Figure 4. It is from this map that the data will be applied to input into the NRMM.

6.0 CONCLUSION

Within the transect there are five NRMM surface roughness classes used to define the geomorphic units. These classes are as follows: Muskeg is Class 1; Till Plain is Class 2; Ground Moraine, Moraine Ridges and Vegetated Moraine Ridges are Class 3; Scree Slopes are Class 5; and Fractured Bedrock is Class 6. Of these units the NRMM surface roughness class was determined for four of them by direct measurement. These four are Till Plain, Moraine Ridges, Vegetated Moraine and Fractured Bedrock. The remaining three units: Muskeg, Ground Moraine and Scree Slopes, had their NRMM surface roughness classes inferred by deduction of their surroundings and the calculation of surface roughness for neighbouring geomorphic units. In all three cases the surface roughness would not be a major factor in calculating the speed across the unit within the NRMM. Other factors such as slope, surface strength and vegetation density would be the determining factor for cross country mobility.

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2. Murphy, N.R., "A Method for Determining Surface Roughness", U.S. Army Engineering Waterways Experiment Station, Geotechnical Laboratory, Vicksburg, Mississippi, 1984. UNCLASSIFIED.
3. Parry, J.T., Granberg, H.B., Howland, W.G., MacLean, P.A., and Houston, L.A., "Report on the Schefferville Transect", McGill University, March 1985, UNCLASSIFIED.

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TABLE 1

IDENTIFICATION OF GEOMORPHIC UNITS WITH THE SURVEYED PROFILES

UNIT DESIGNATION	SURVEY PROFILE NUMBER
Muskeg	8
Fractured Bedrock	35 36 37 45
Moraine Ridges	5 6 7 9 14 15 16 20 21 22 23 24 25 26 27 29 30 31 32 33 34 38 39 40 41 42 44 46 61
Vegetated Moraine Ridges	17 18 19 28 47 48 49 50 51 52 53 54 55 56 57 58 59 60 62 63
Till Plain	1 2 3 10 11 12 13 43
Scree Slopes	4
Vegetated Ground Moraine	

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TABLE 2

IDENTIFICATION OF SURFACE ROUGHNESS VALUES
WITH THE APPROPRIATE NRMM CLASS AND GEOMORPHIC UNIT

MUSKEG:		8 Note: This was a Spagnum Moss Bog that was well drained. Most Muskeg areas are waterlogged or RMS Value (mm) 64 covered in water. The RMS value of 64 is questionable due to sinkage of the profiling rod.	
RMS Class	3		
FRACTURED BEDROCK:		NRMM Class Average = 5.75	
Profile #	35 36 37 45		
RMS Value (mm)	73 91 173 120		
RMS Class	4 5 8 6		
MORaine RIDGES:		NRMM Class Average = 2.93	
Profile #	5 6 7 9 14 15 16 20 21 22 23 24 25 26 27 29 30 31 32 33 34 38 39 40 41 42 44 46 61		
RMS Value (mm)	50 50 35 54 52 63 85 54 29 55 42 49 21 54 56 50 71 48 53 31 34 81 45 62 79 86 49 32 29		
RMS Class	3 3 2 3 3 3 4 3 2 3 3 3 2 3 3 4 3 3 2 2 4 3 3 4 4 3 2 2		
VEGETATED MORaine RIDGES:		NRMM Class = 3	
Profile #	17 18 19 28 47 48 49 50 51 52 53 54 55 56 57 58 59 60 62 63		
RMS Value (mm)	38 28 42 60 34 41 46 33 29 58 49 38 43 61 75 27 48 36 39 62		
RMS Class	2 2 3 3 2 3 2 3 2 2 3 3 2 3 3 4 2 3 2 3 3		
		NRMM Class Average = 2.65	
		NRMM Class = 3	

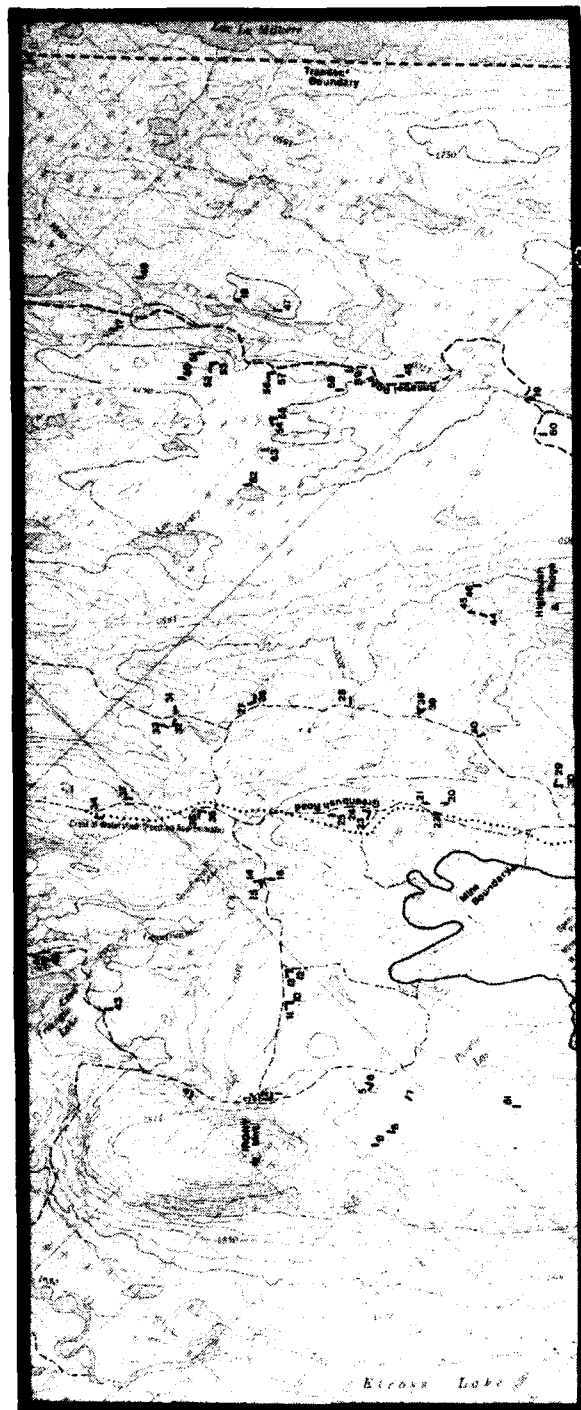
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TABLE 2

IDENTIFICATION OF SURFACE ROUGHNESS VALUES
WITH THE APPROPRIATE NRMM CLASS AND GEOMORPHIC UNIT
(continued)

TILL PLAIN:															
Profile #	1	2	3	10	11	12	13	43	NRMM Class Average = 2.375						
RMS Value (mm)	39	42	32	39	38	36	32	33	NRMM Class = 2						
RMS Class	3	3	2	3	2	2	2	2							
SCREE SLOPES:															
Profile #	4														
RMS Value (mm)	63														
RMS Class	3														
VEGETATED GROUND MORaine: No profiles due to closed lichen woodland.															

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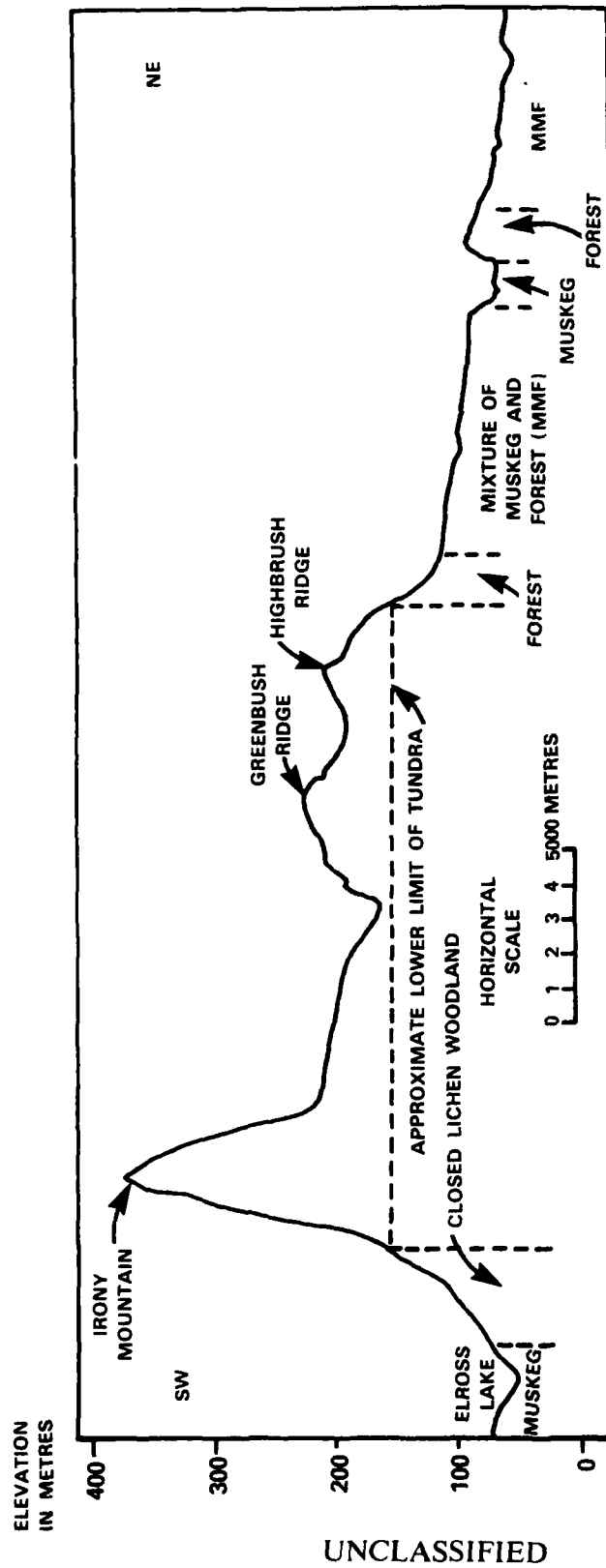
1. PROFILE LOCATION WITH APPROXIMATE ORIENTATION

Figure 1

SCHEFFERVILLE TRANSPORT ABD PROFILE LOCATION

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NOTE: WHERE AN AREA IS LABELLED AS FOREST, BOTH CLOSED
AND OPEN LICHEN WOODLAND CAN EXIST

Figure 2
CROSS PROFILE OF SCHEFFERVILLE TRANSECT

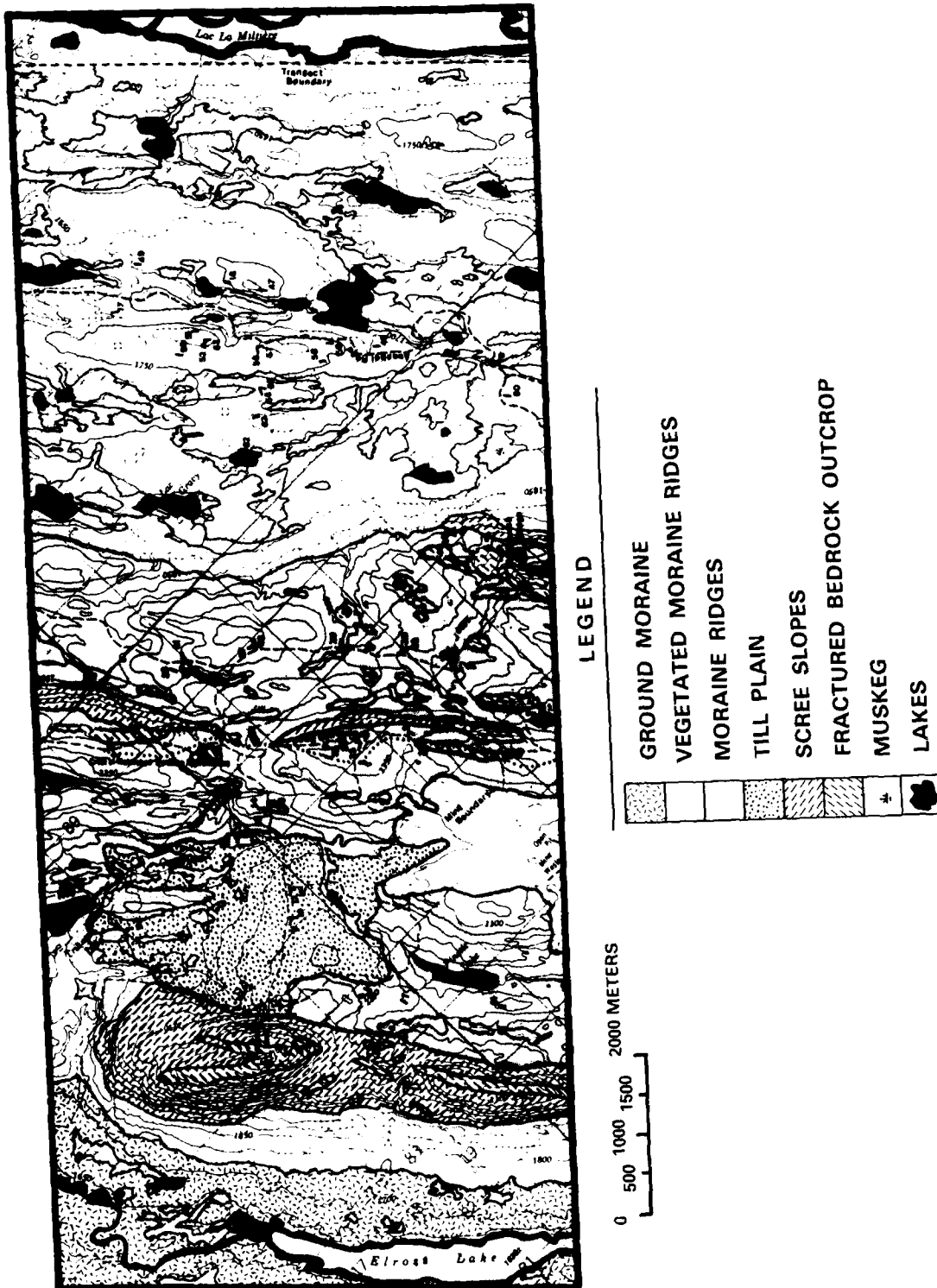
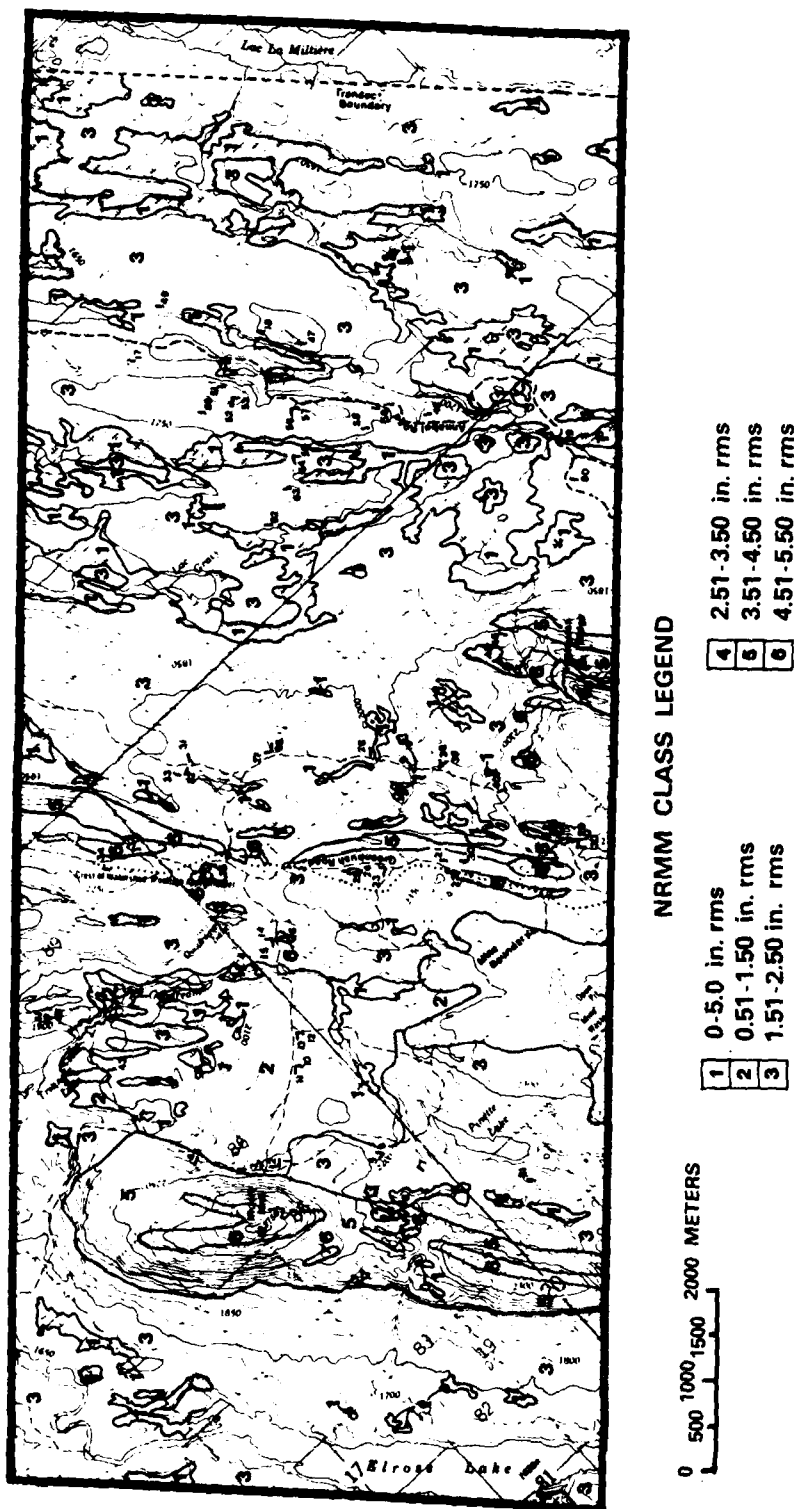


Figure 3
SCHEFFERVILLE GEOMORPHOLOGY MAP

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Figure 4
SCHERFFERVILLE NRM CLASS MAP

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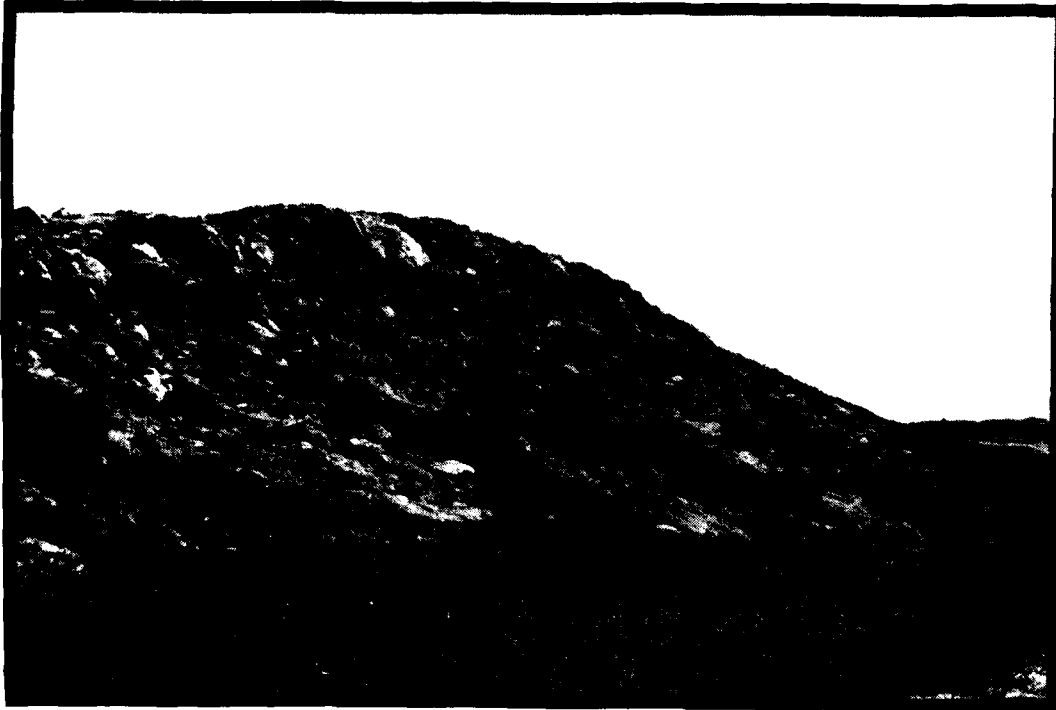
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Figure 5
IRONSTONE BEDROCK OUTCROP

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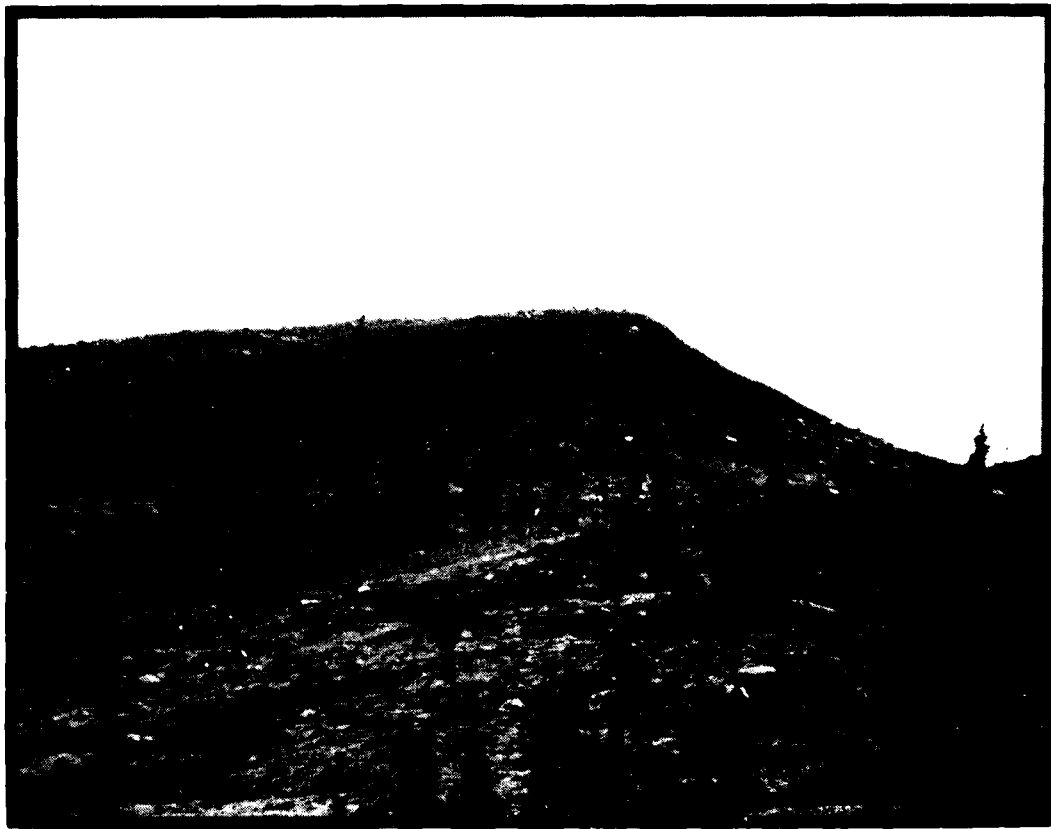
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Figure 6
FROST SHATTERED RIDGE OURCROP

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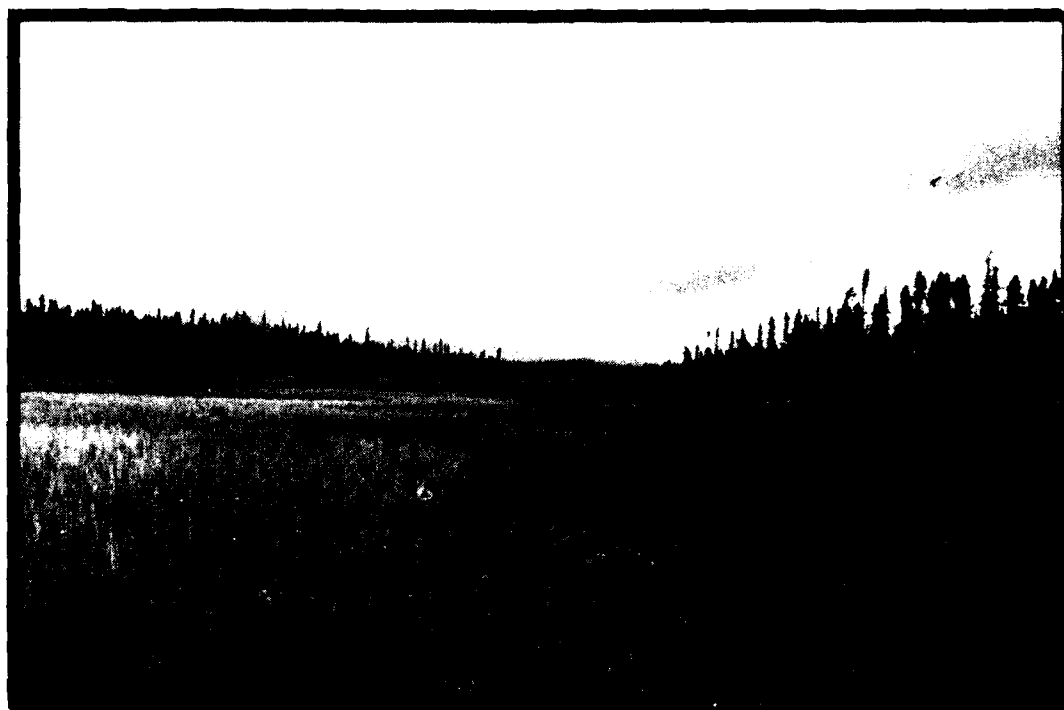


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Figure 7
RIDGE AND SCREE SLOPED

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Figure 8

MUSKEG

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ANNEX A

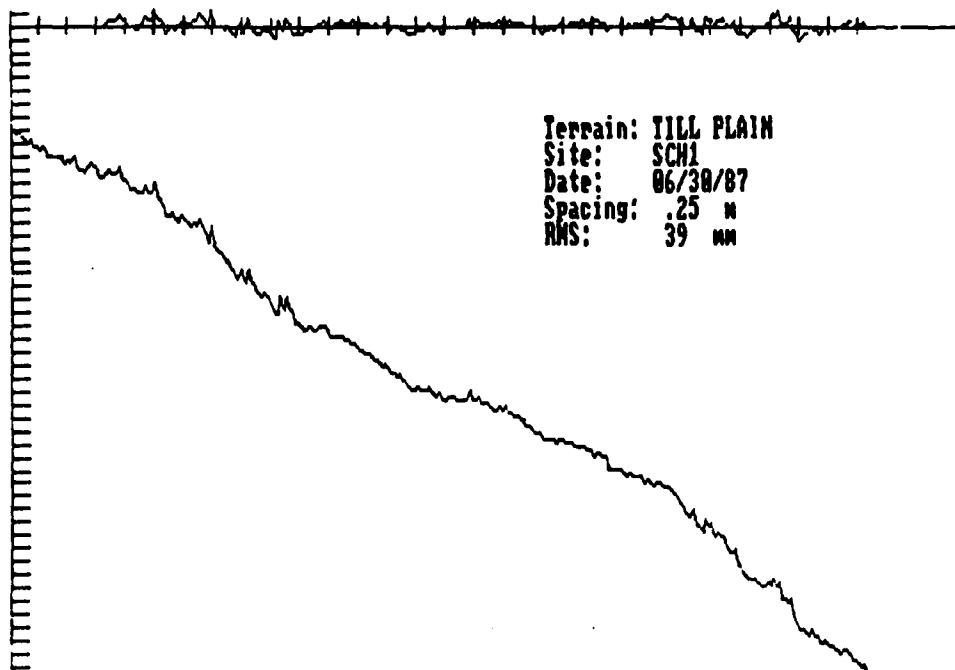
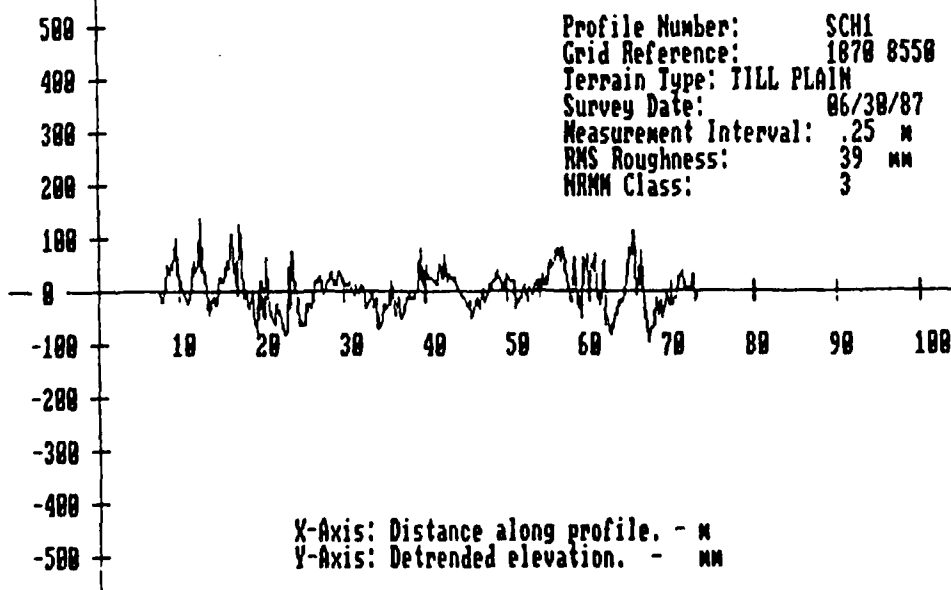
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Note!

The detrended horizontal lengths in both upper and lower
graphs are the same

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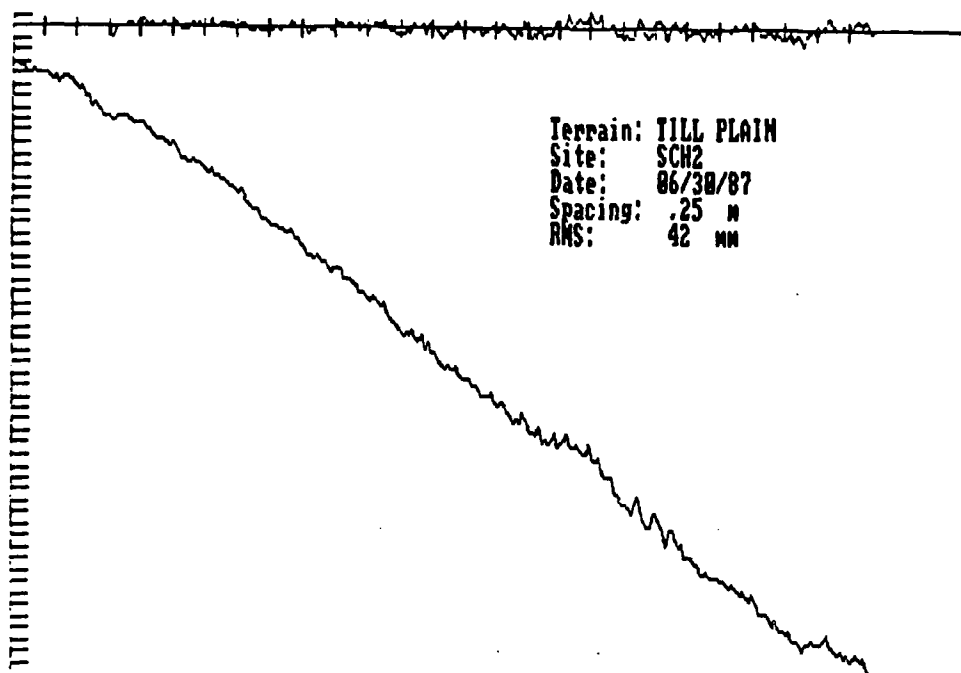
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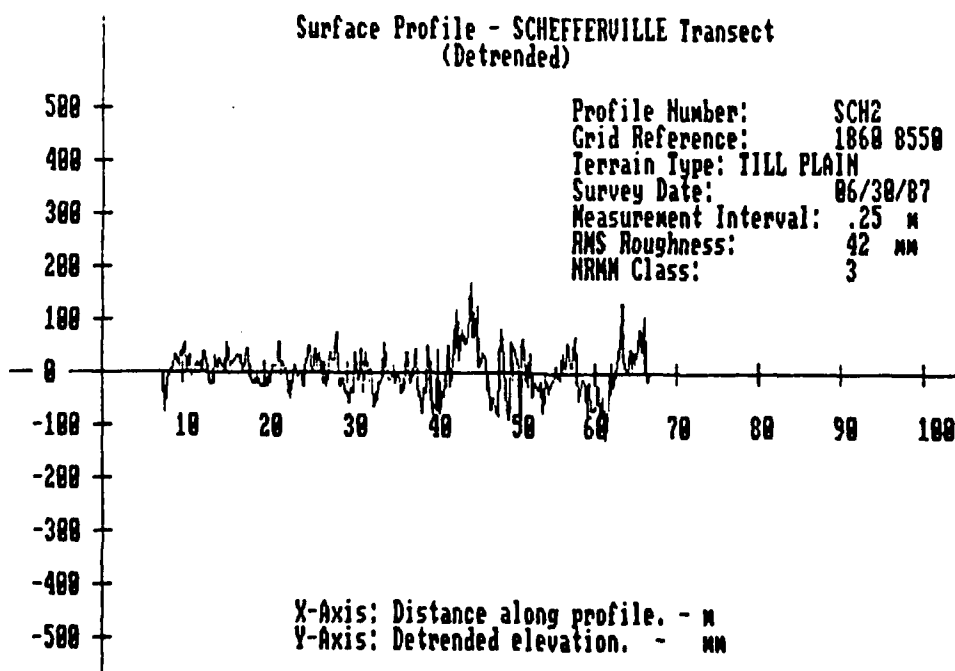
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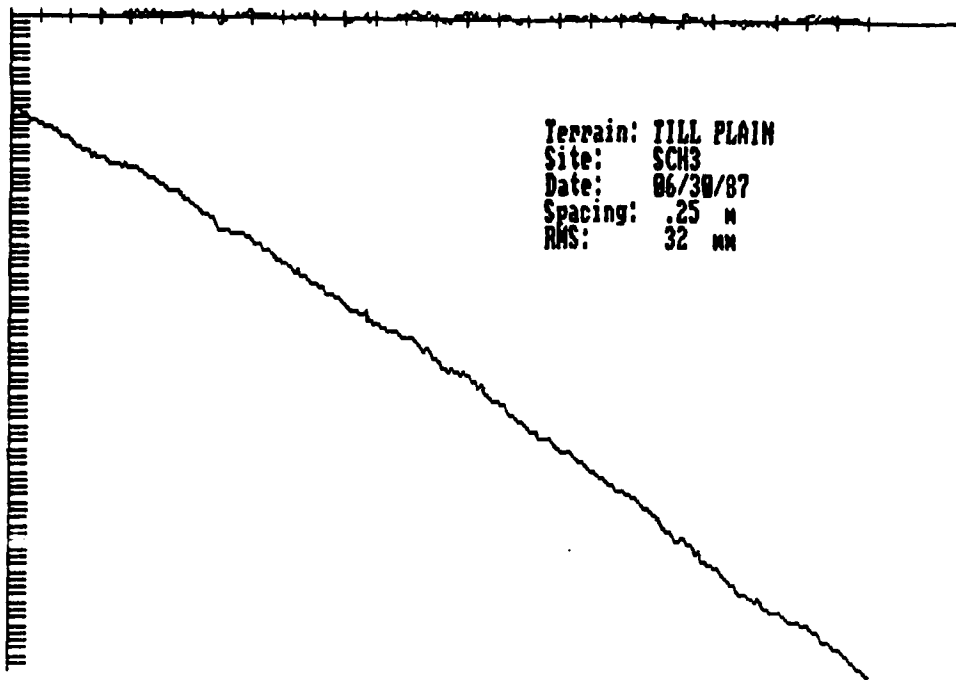


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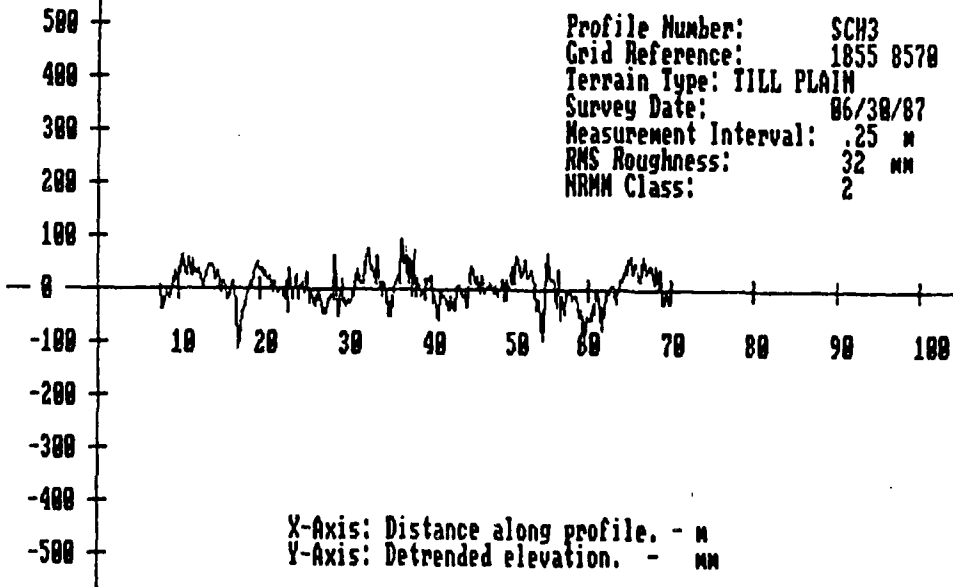
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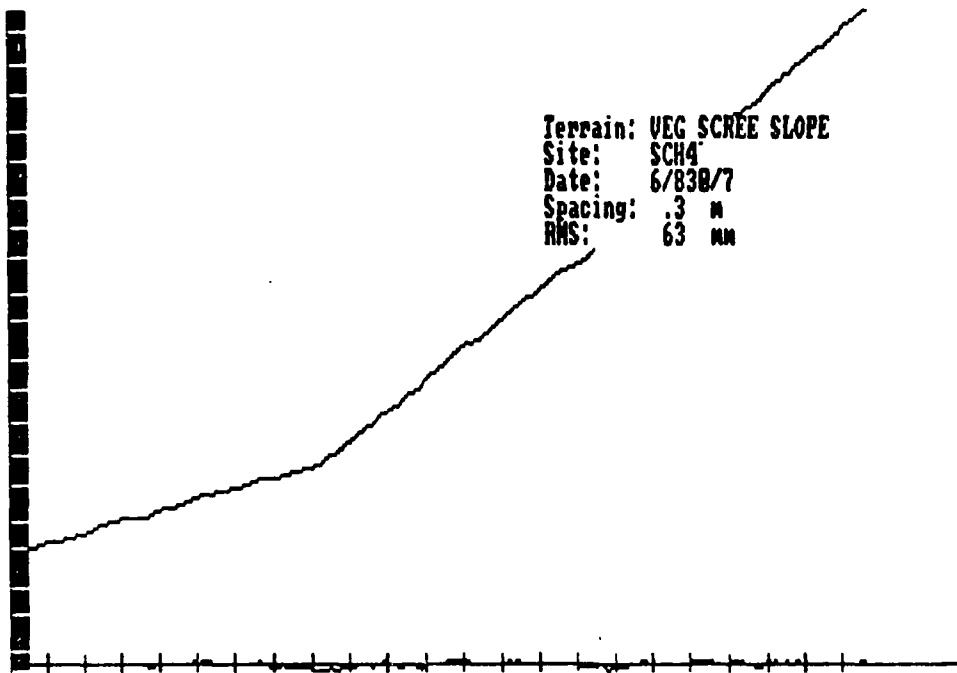


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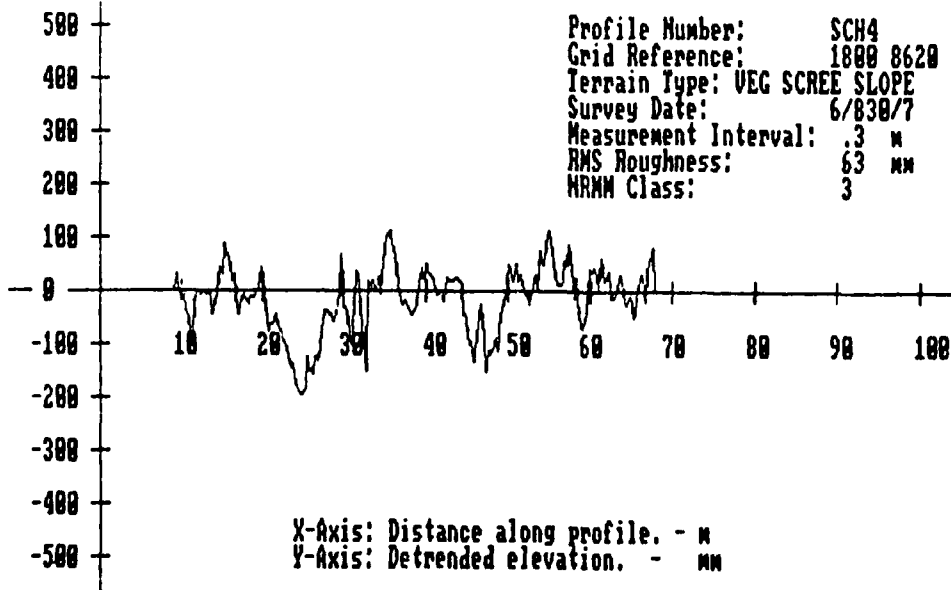
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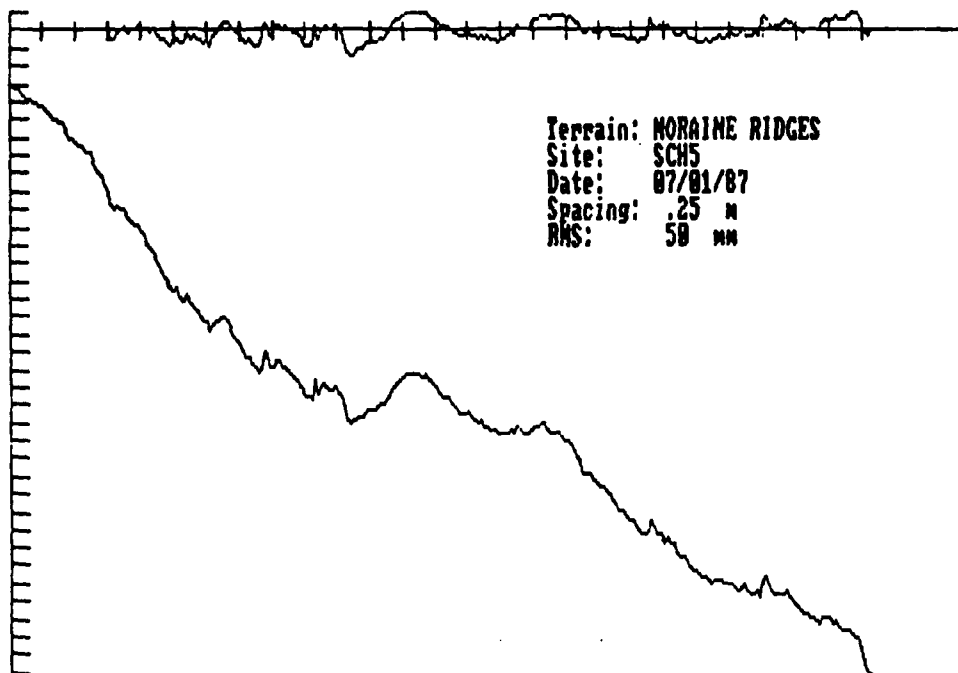


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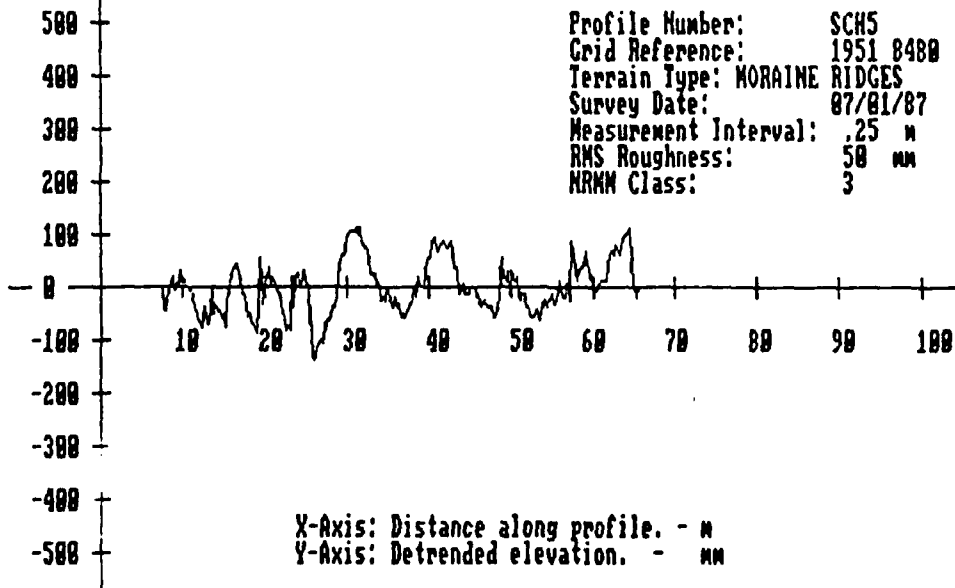
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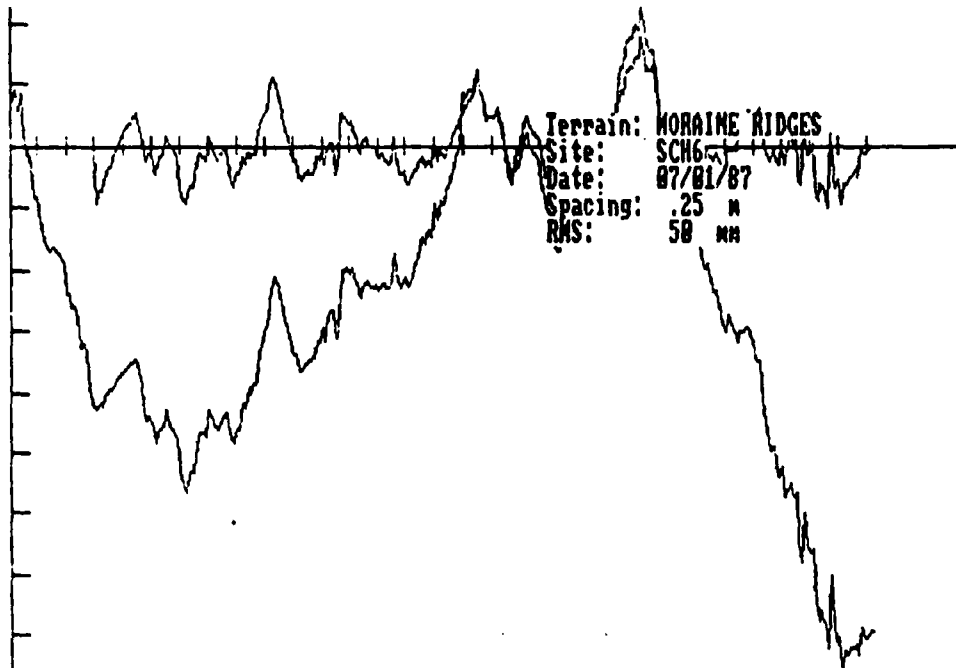


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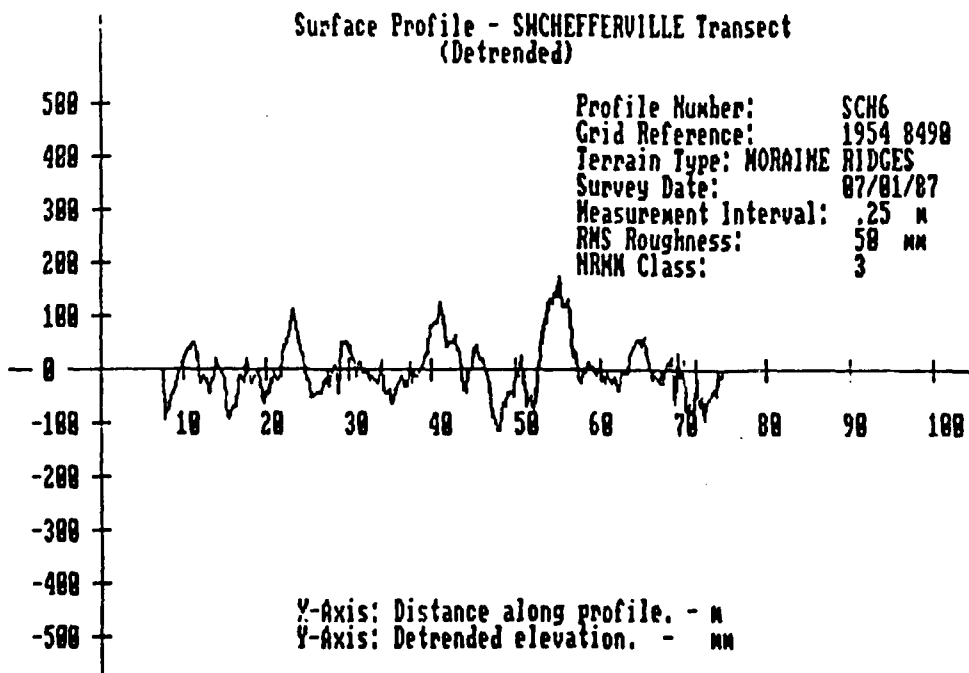
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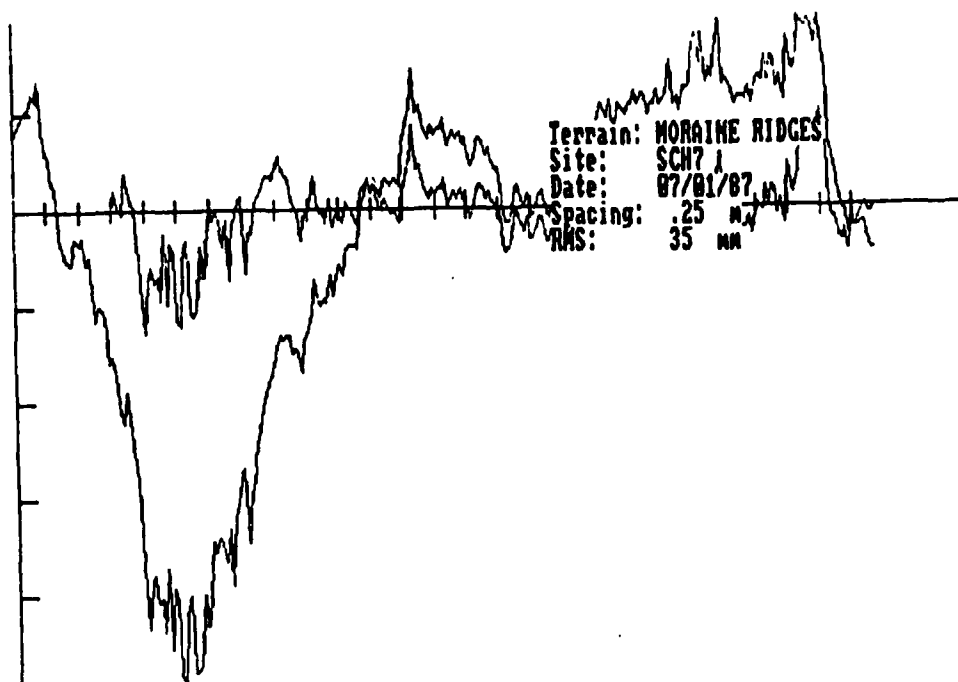


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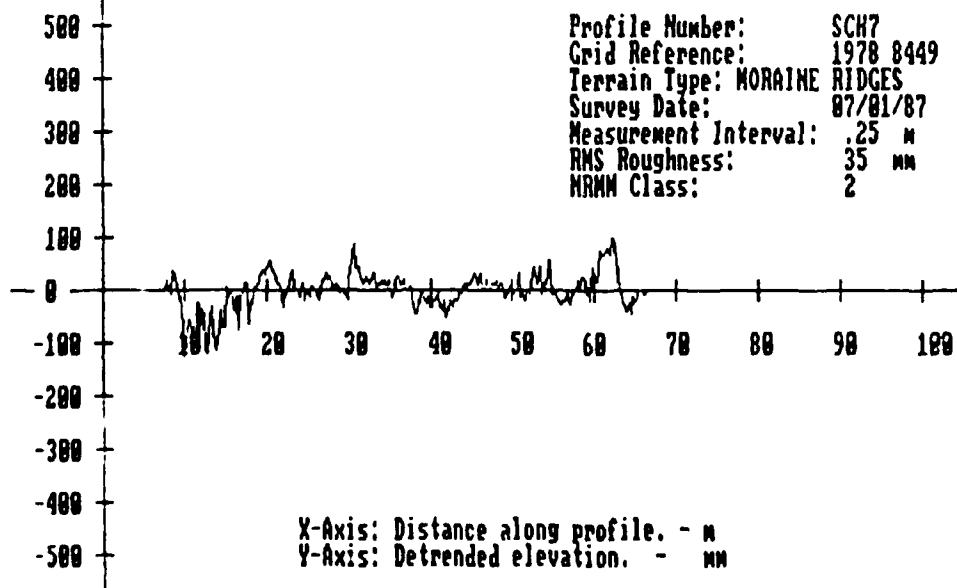
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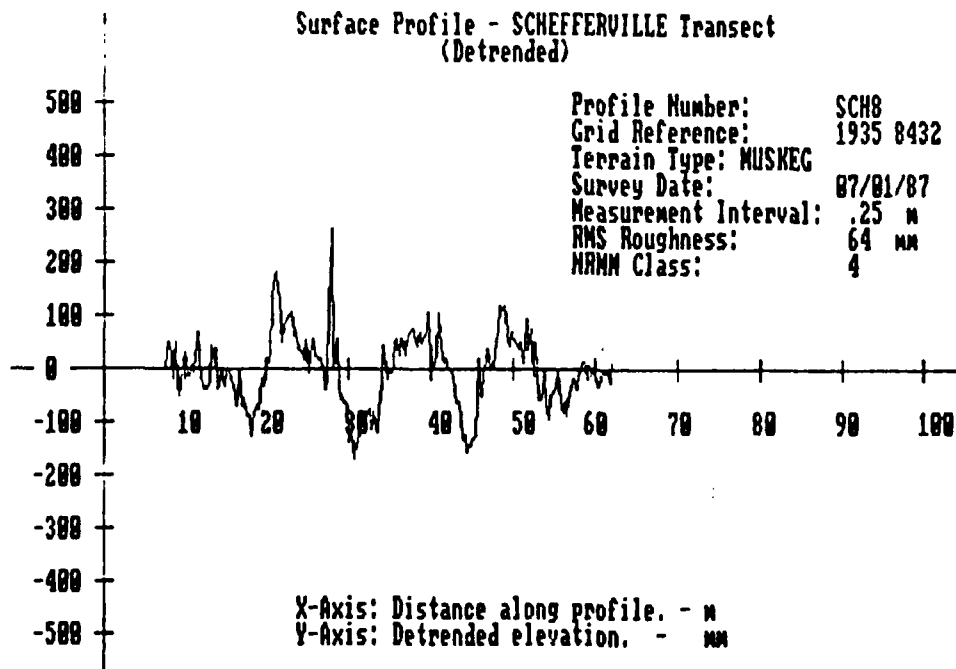
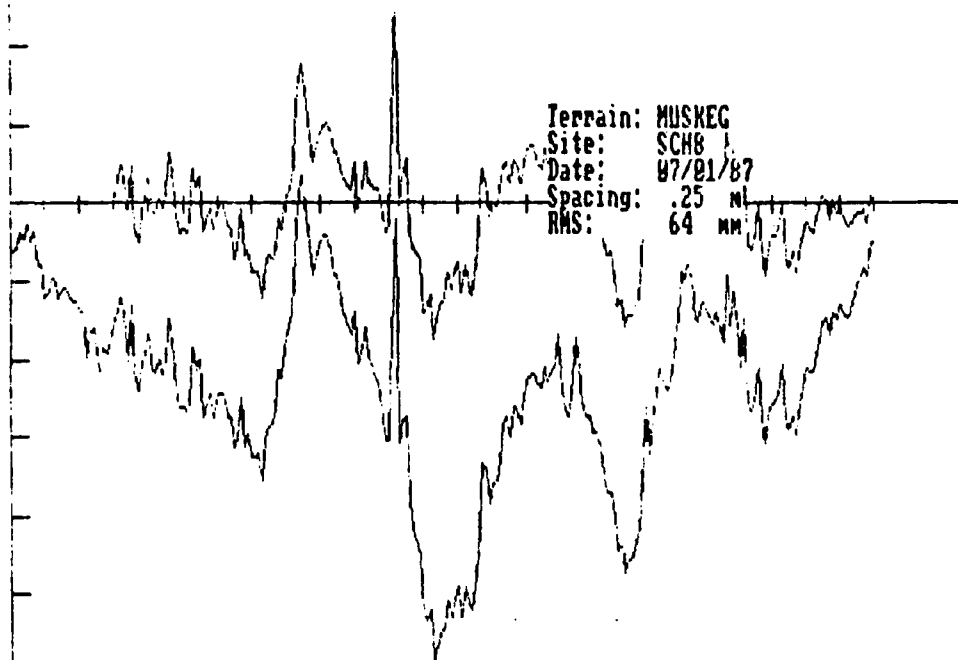


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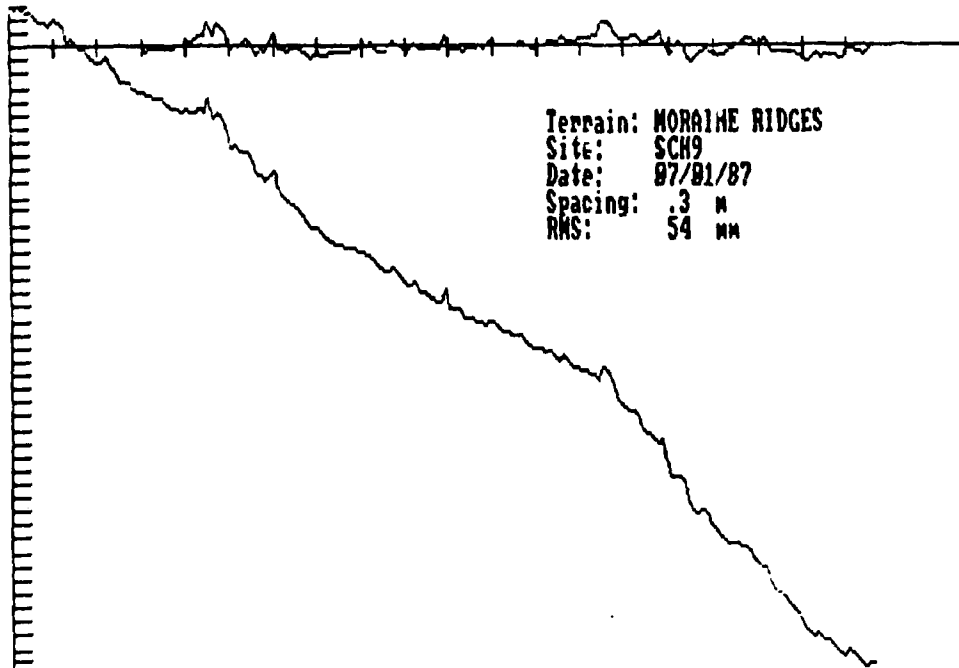


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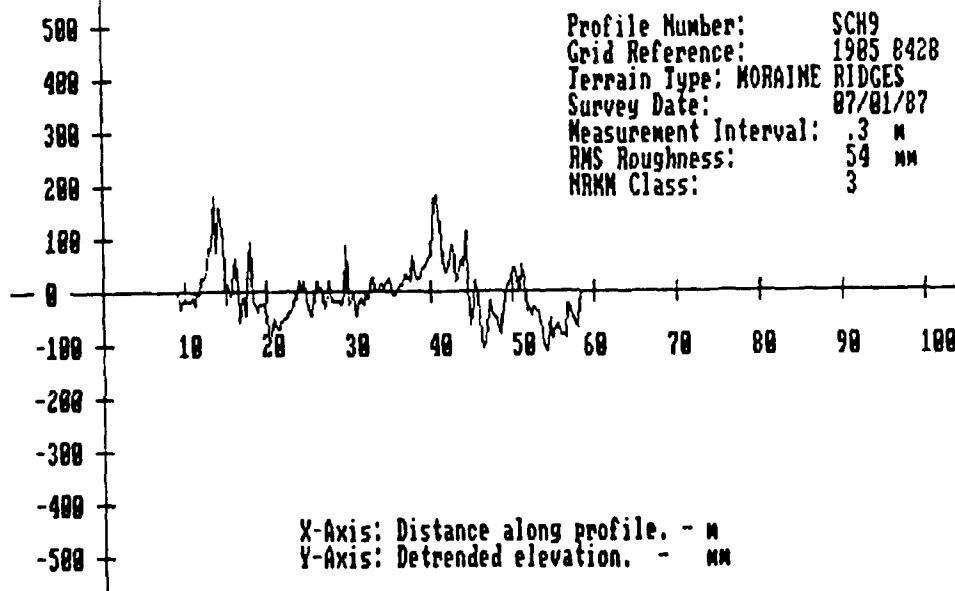
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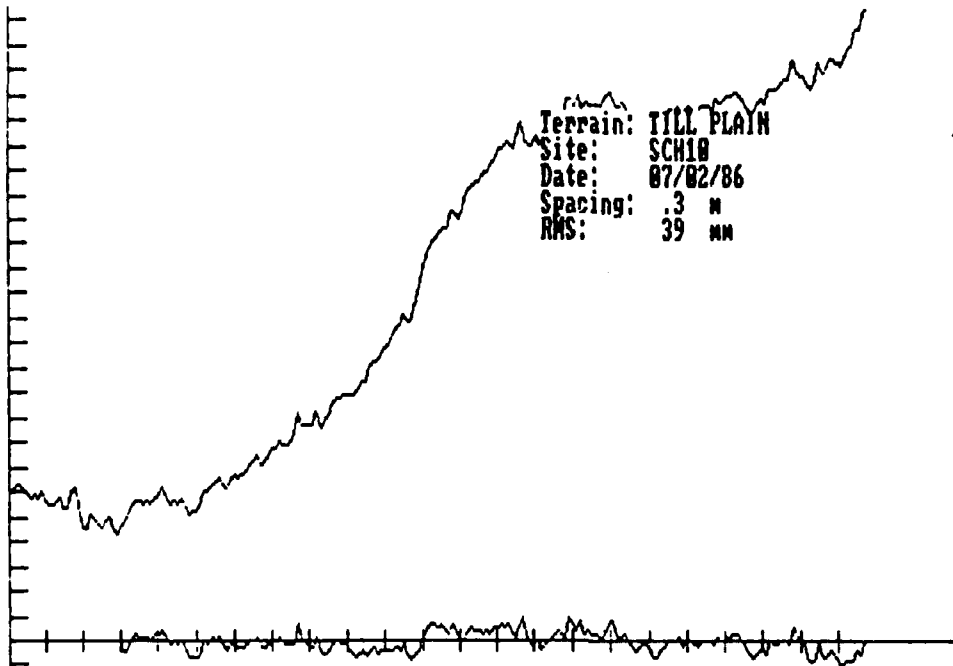


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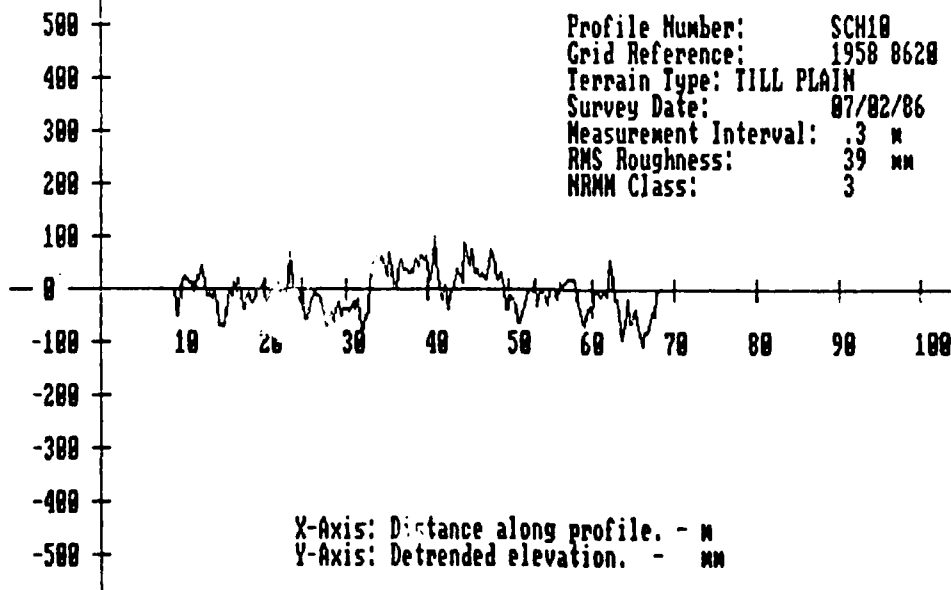
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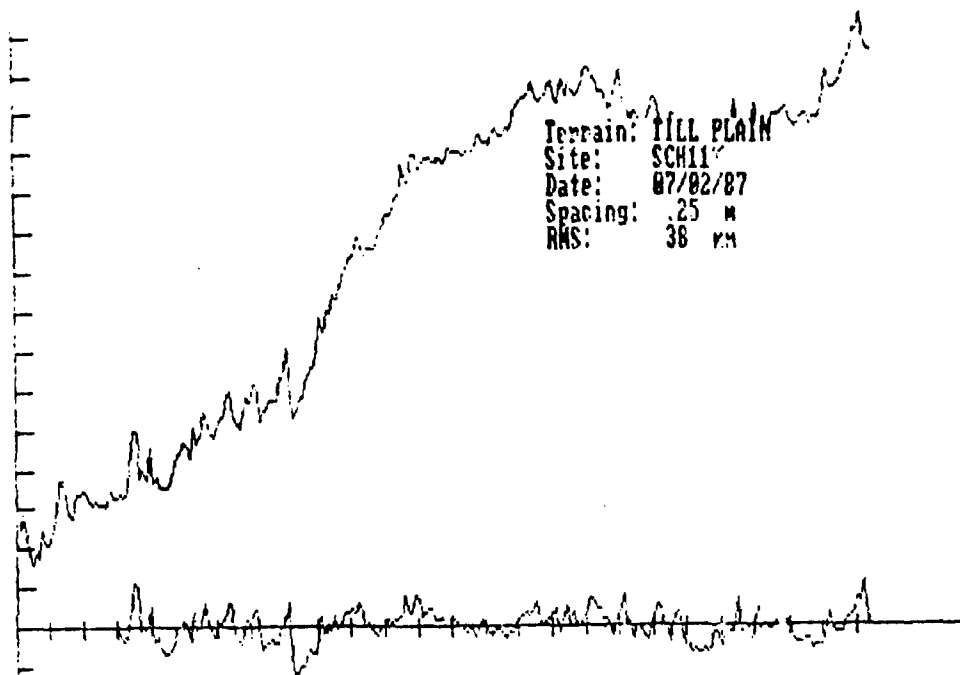
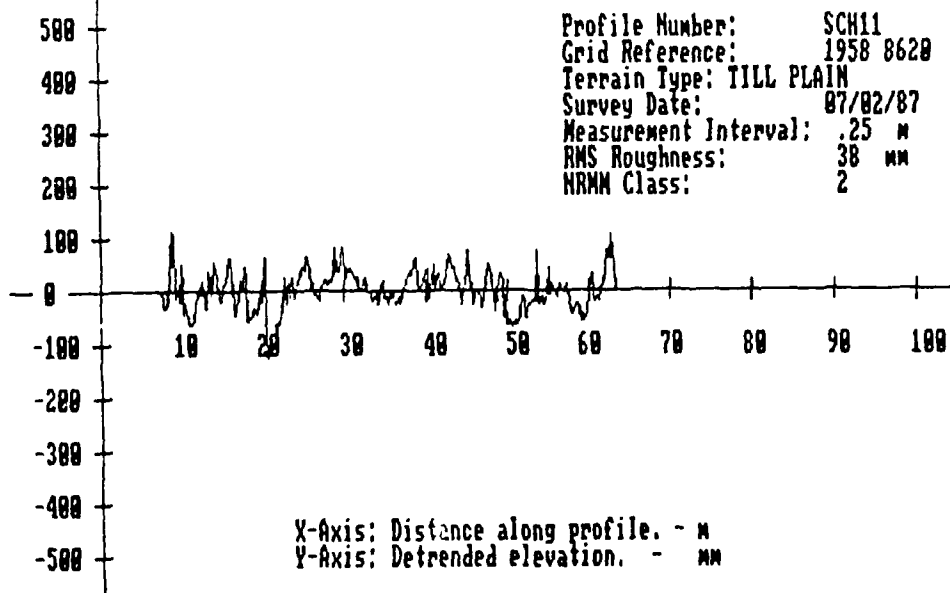


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

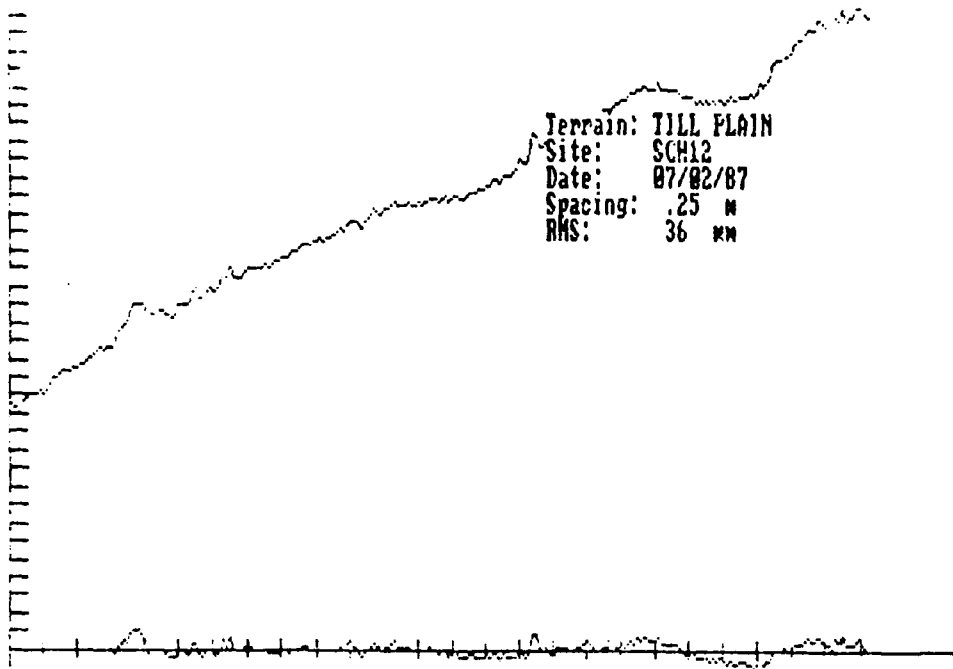
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

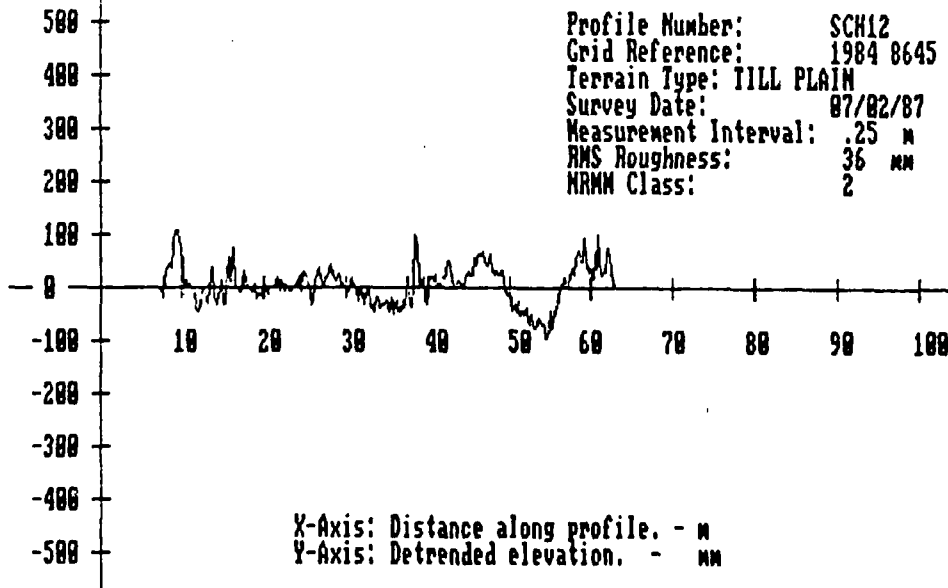
UNCLASSIFIED

/A-13

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

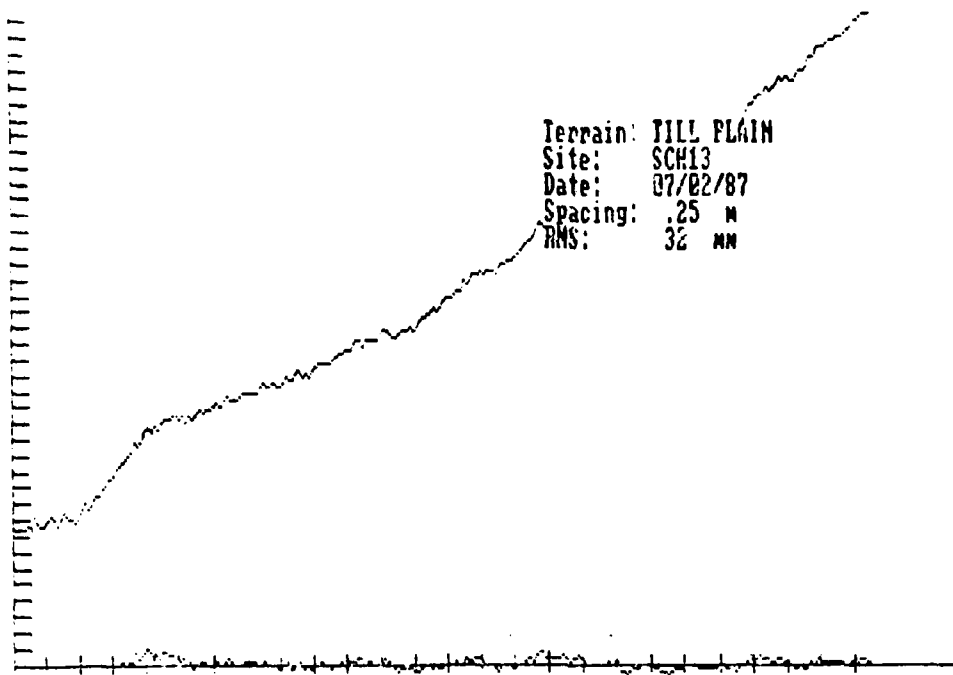


UNCLASSIFIED

UNCLASSIFIED

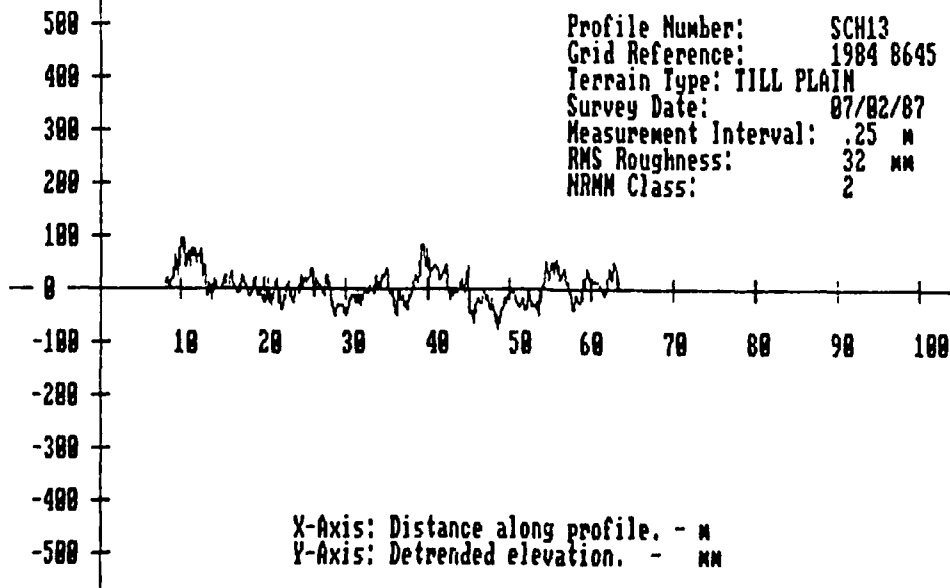
/A-14

(Raw Data)



Terrain: TILL PLAIN
Site: SCH13
Date: 07/02/87
Spacing: .25 m
RMS: 32 mm

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

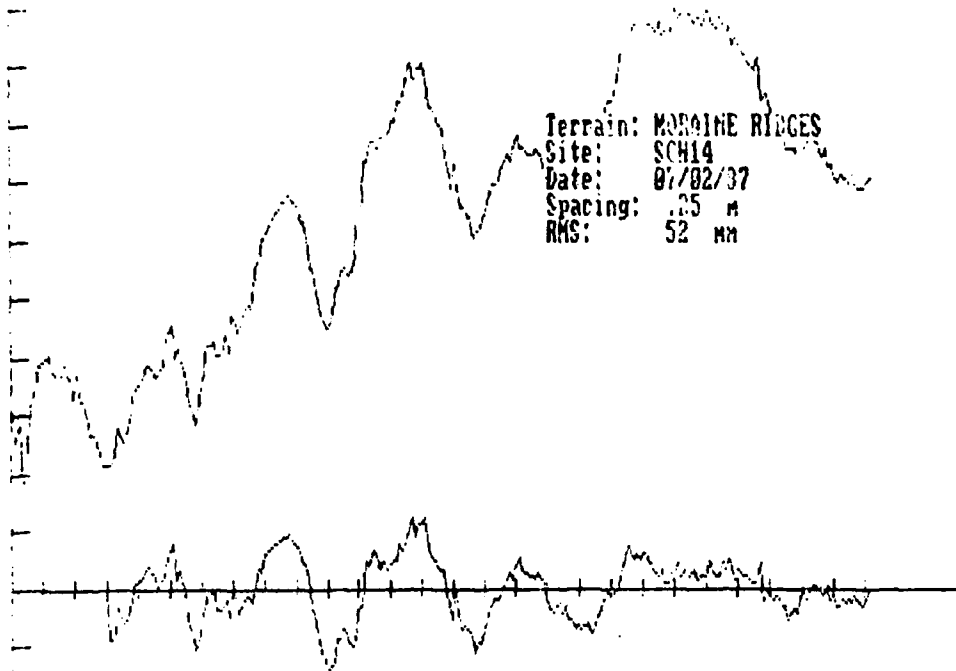


UNCLASSIFIED

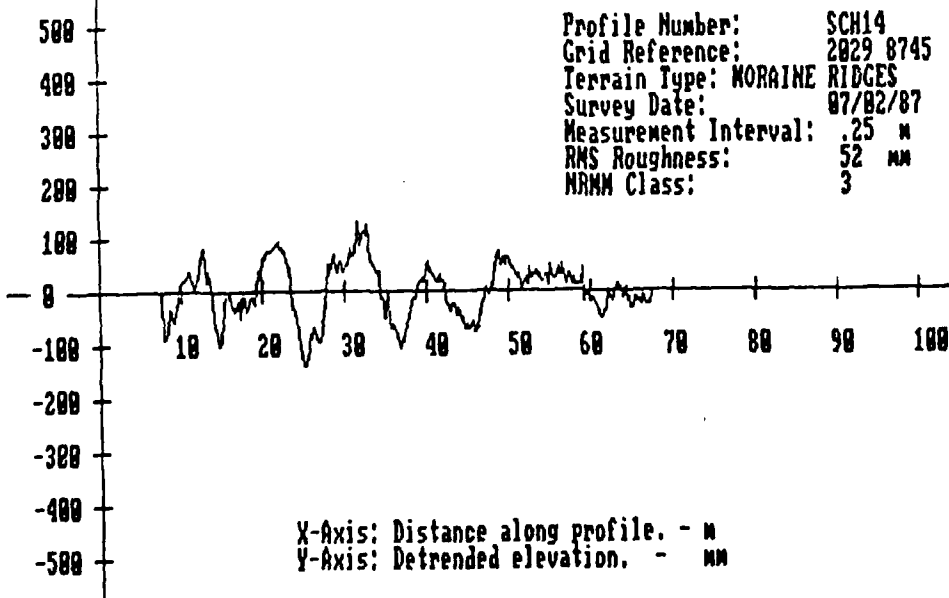
UNCLASSIFIED

/A-15

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

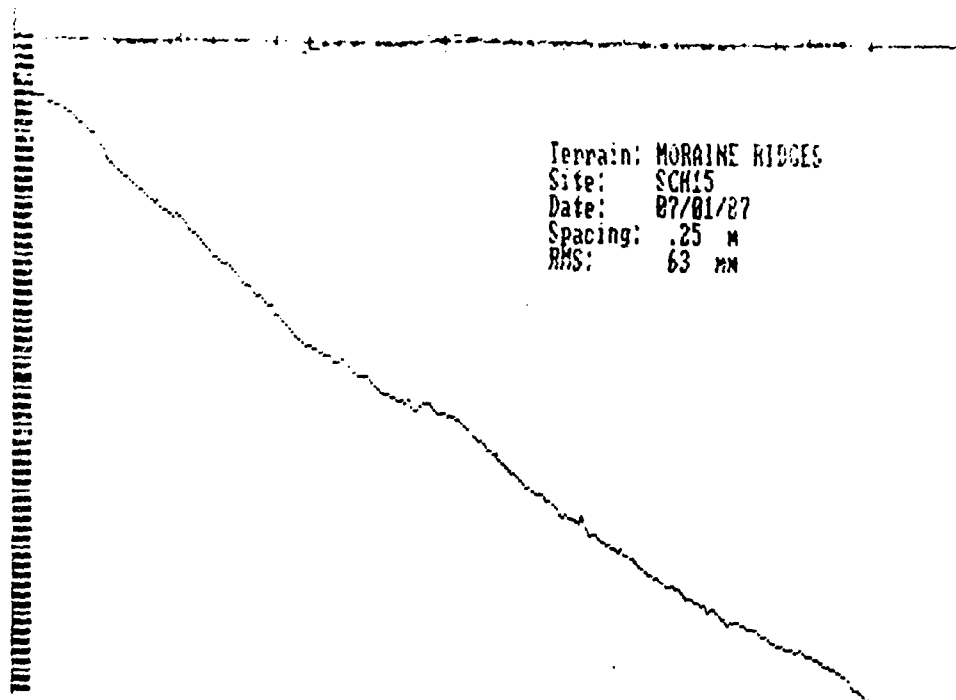


UNCLASSIFIED

UNCLASSIFIED

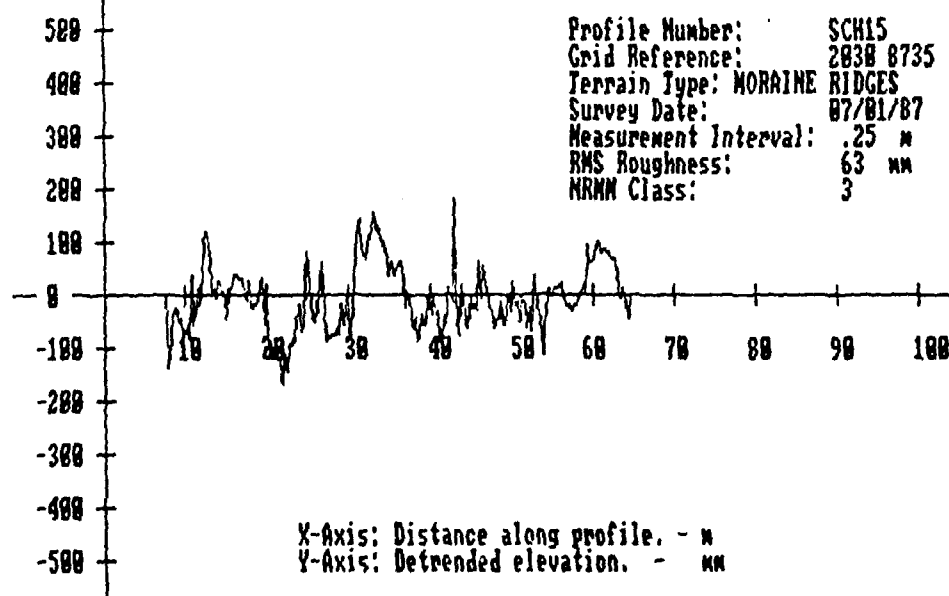
/A-16

(Raw Data)



Terrain: MORaine RIDGES
Site: SCH15
Date: 07/01/87
Spacing: .25 m
RMS: 63 mm

Surface Profile - SCHEFFERVILLE Transect
(Detrended)



Profile Number: SCH15
Grid Reference: 2838 8735
Terrain Type: MORaine RIDGES
Survey Date: 07/01/87
Measurement Interval: .25 m
RMS Roughness: 63 mm
NRMM Class: 3

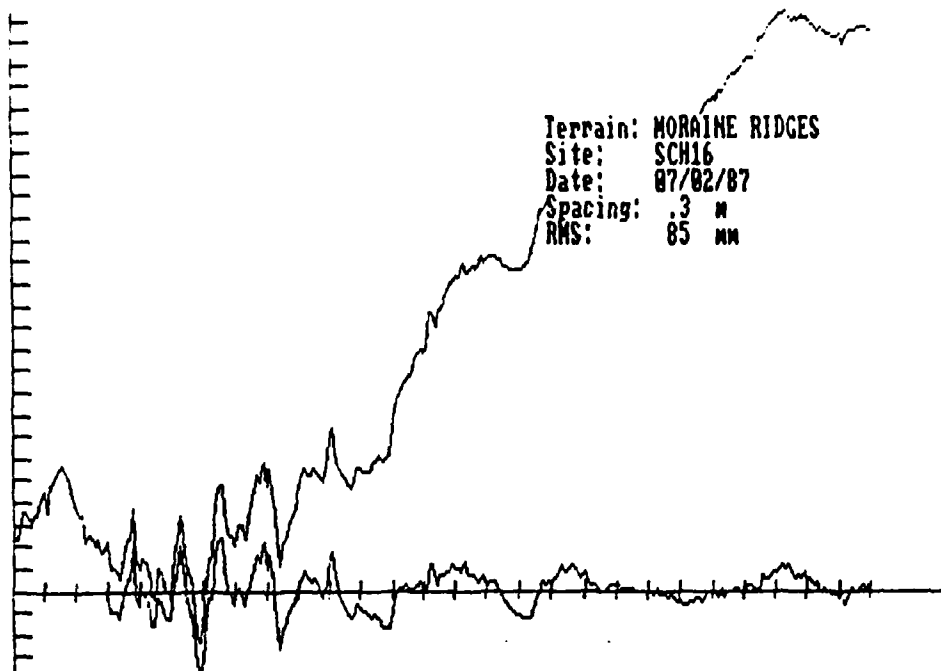
X-Axis: Distance along profile. - m
Y-Axis: Detrended elevation. - mm

UNCLASSIFIED

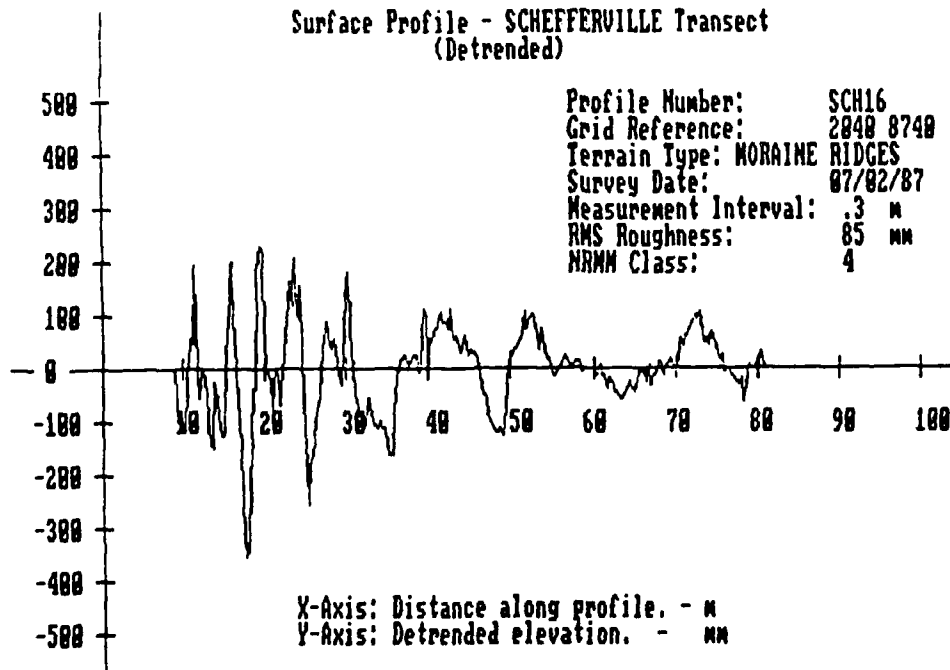
UNCLASSIFIED

/A-17

(Raw Data)

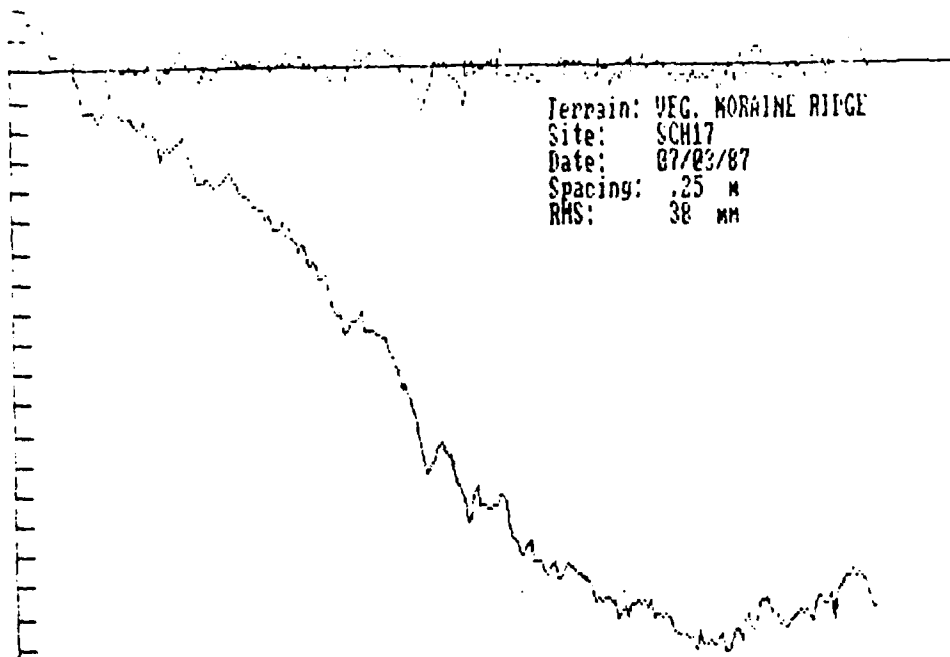
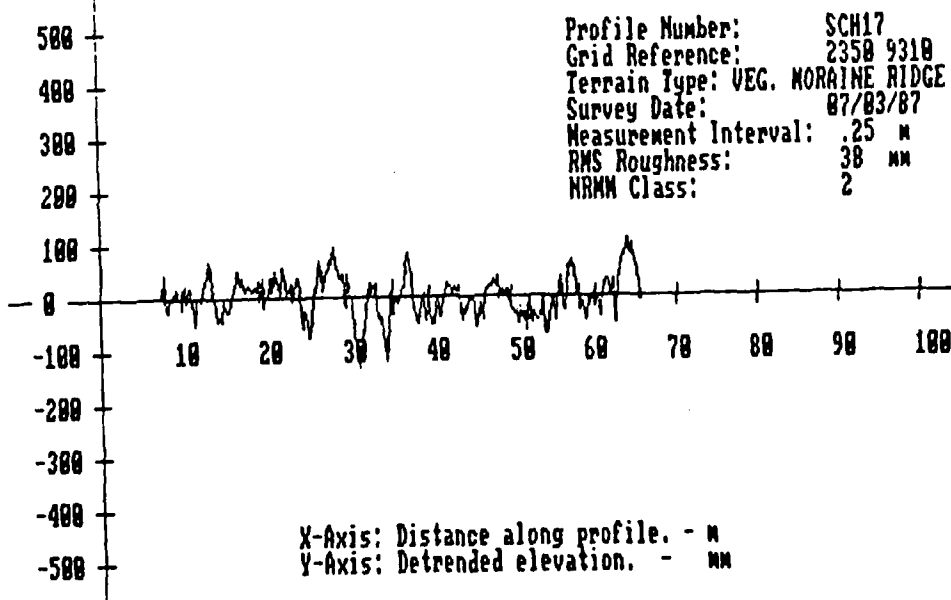


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

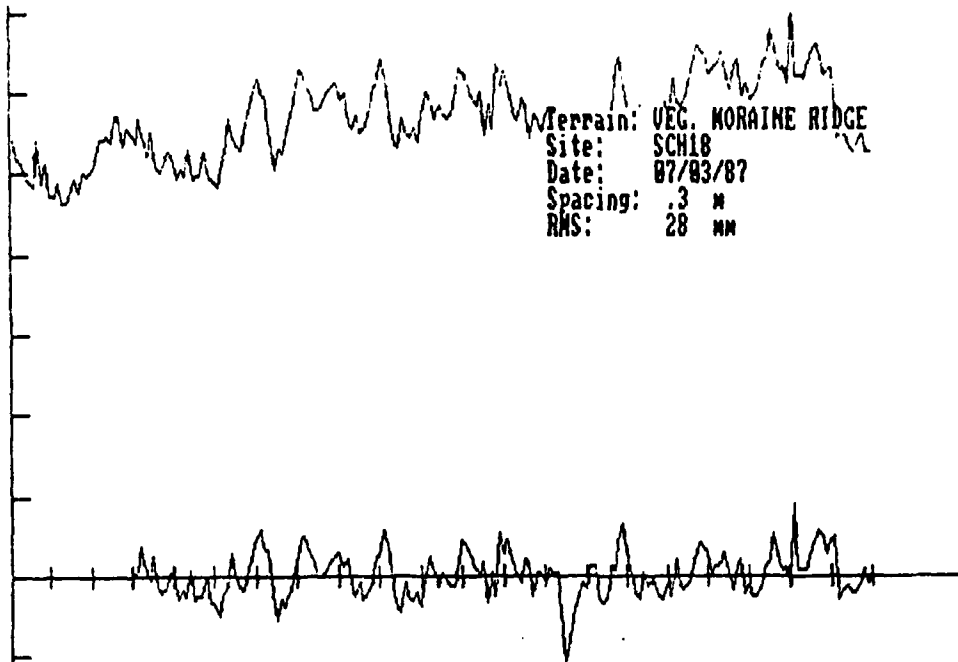
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

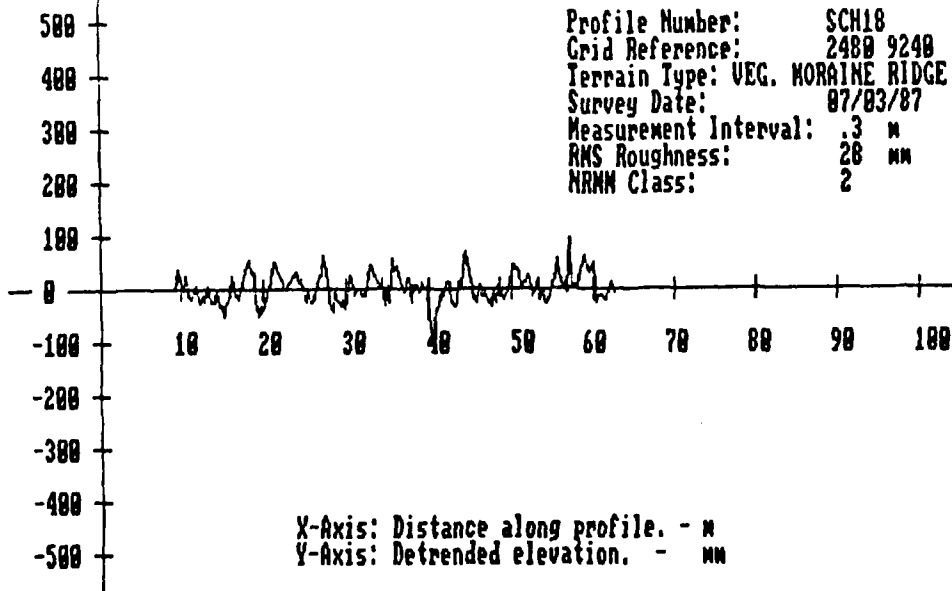
UNCLASSIFIED

/A-19

(Raw Data)

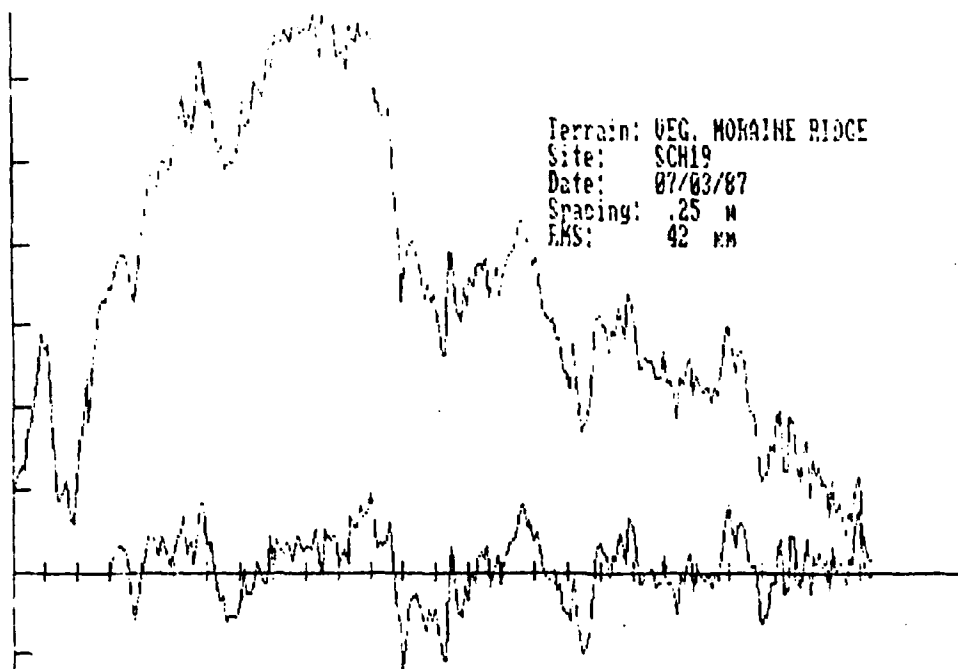
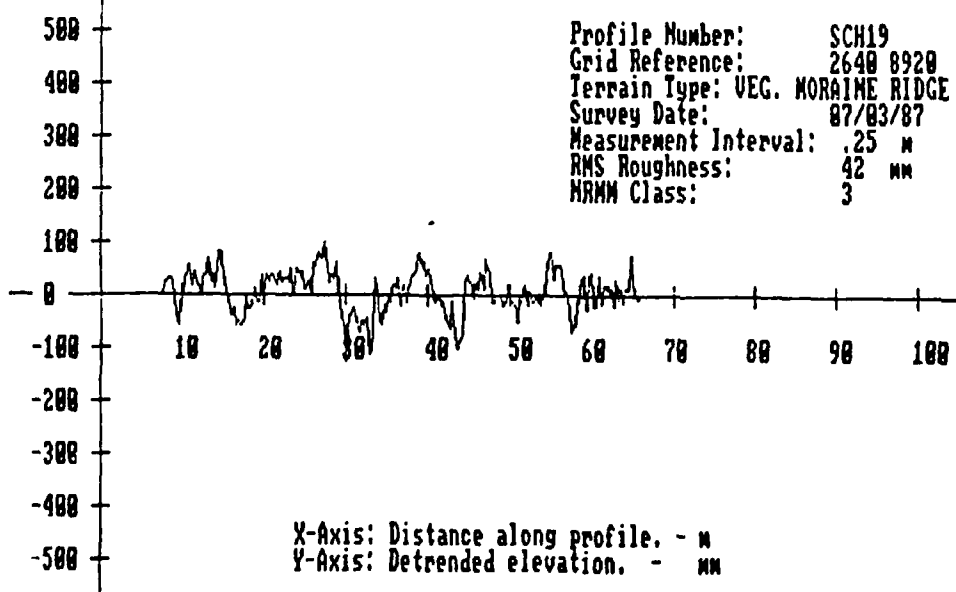


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

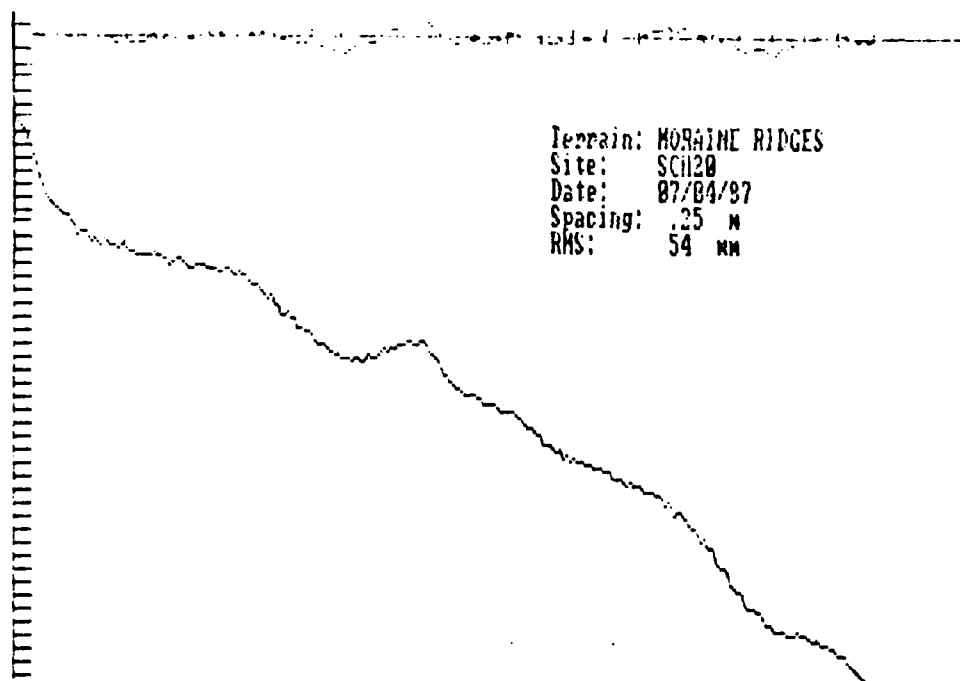
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

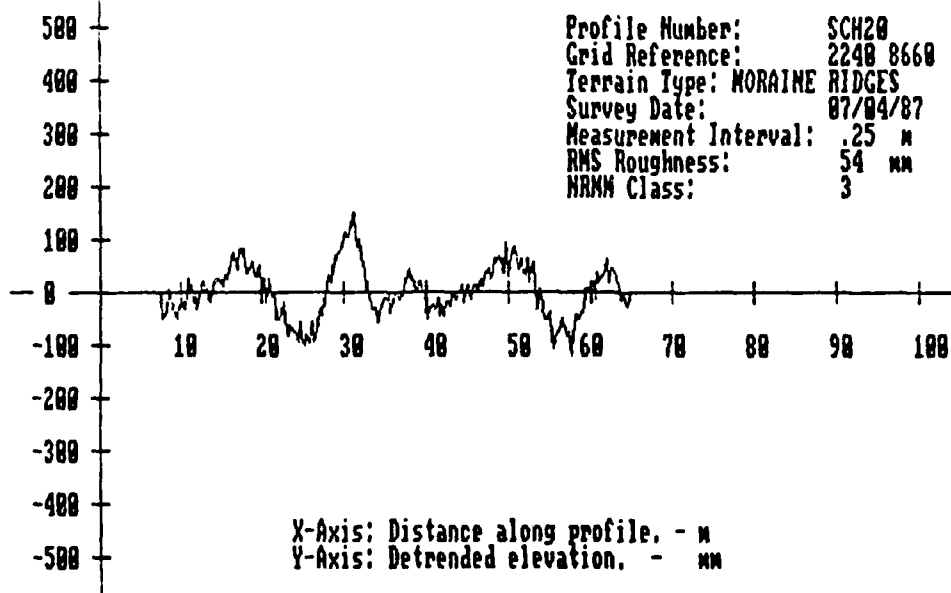
UNCLASSIFIED

/A-21

(Raw Data)

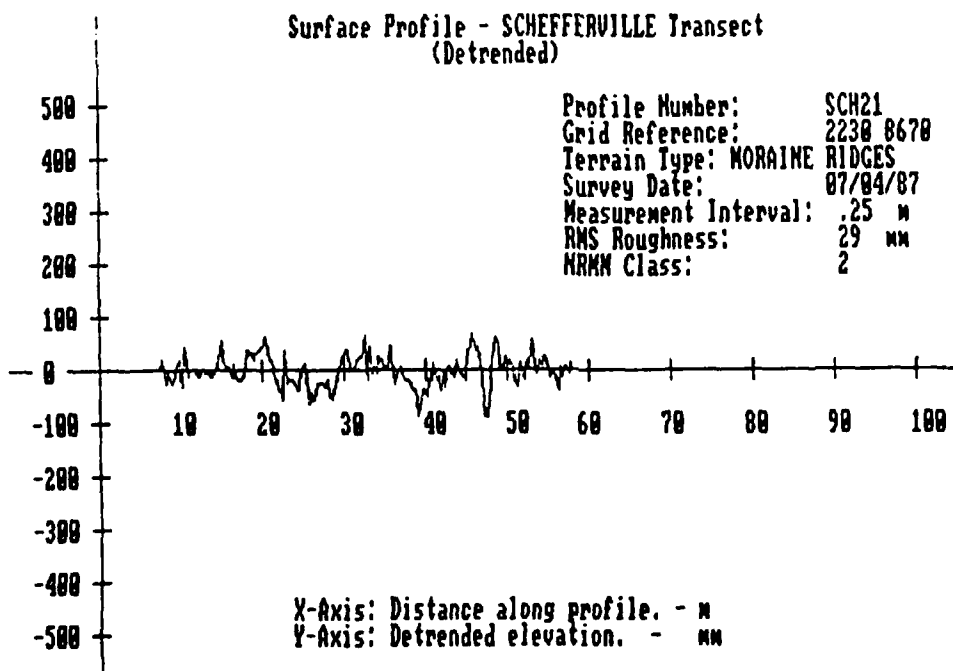
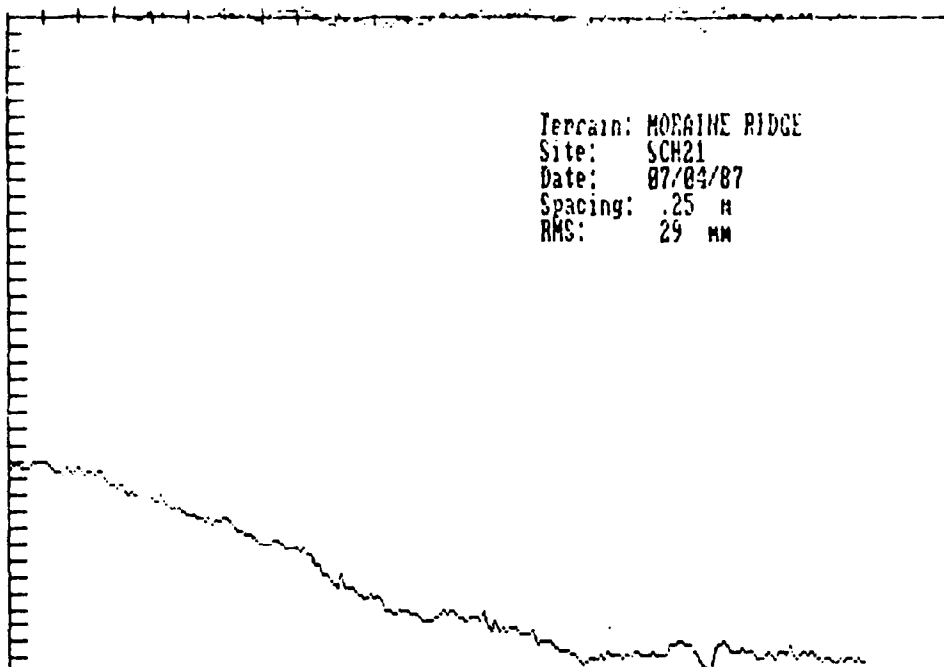


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

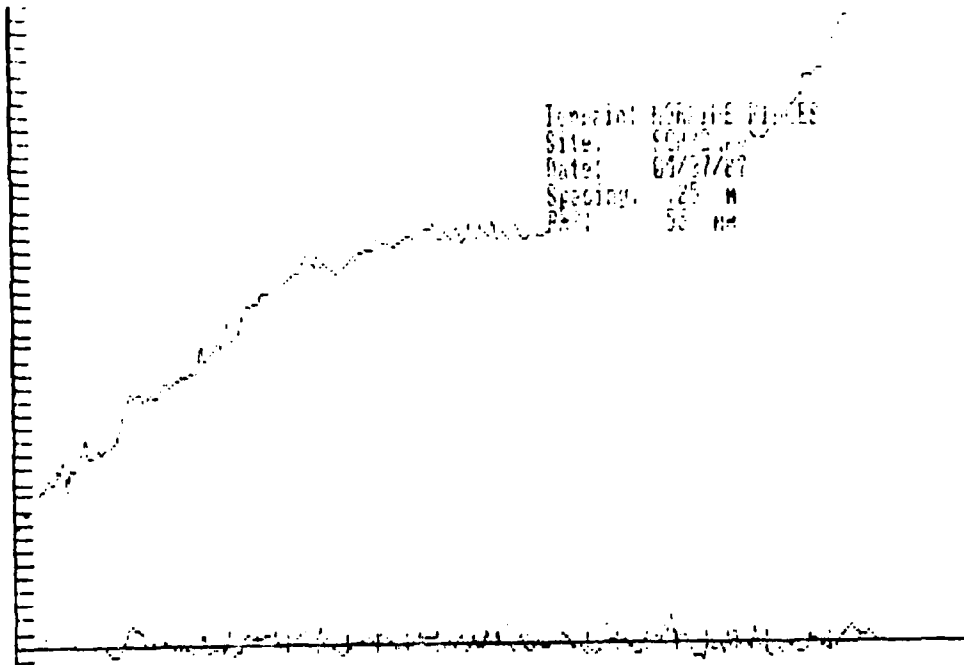
(Raw Data)



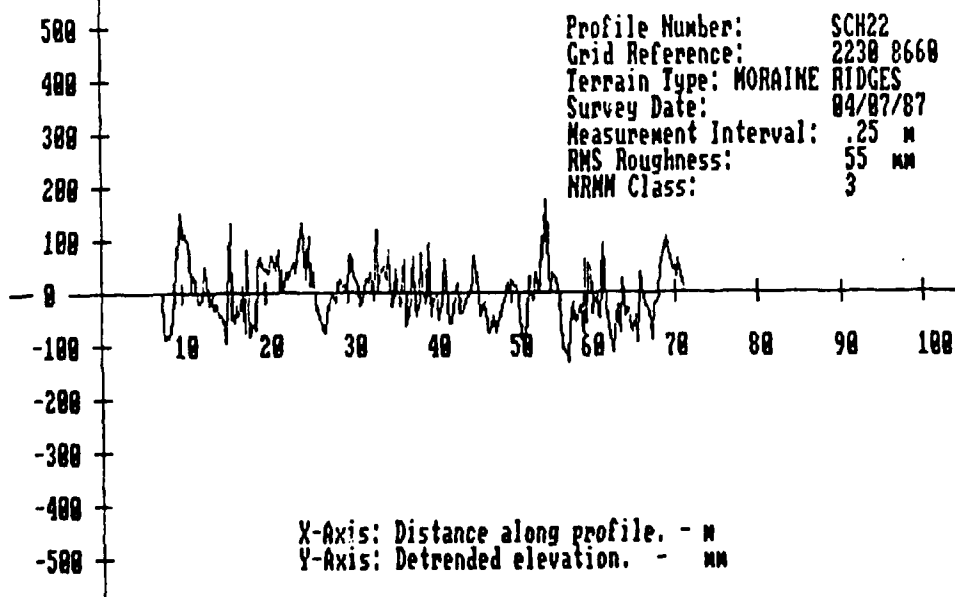
UNCLASSIFIED

/A-23

(Raw Data)

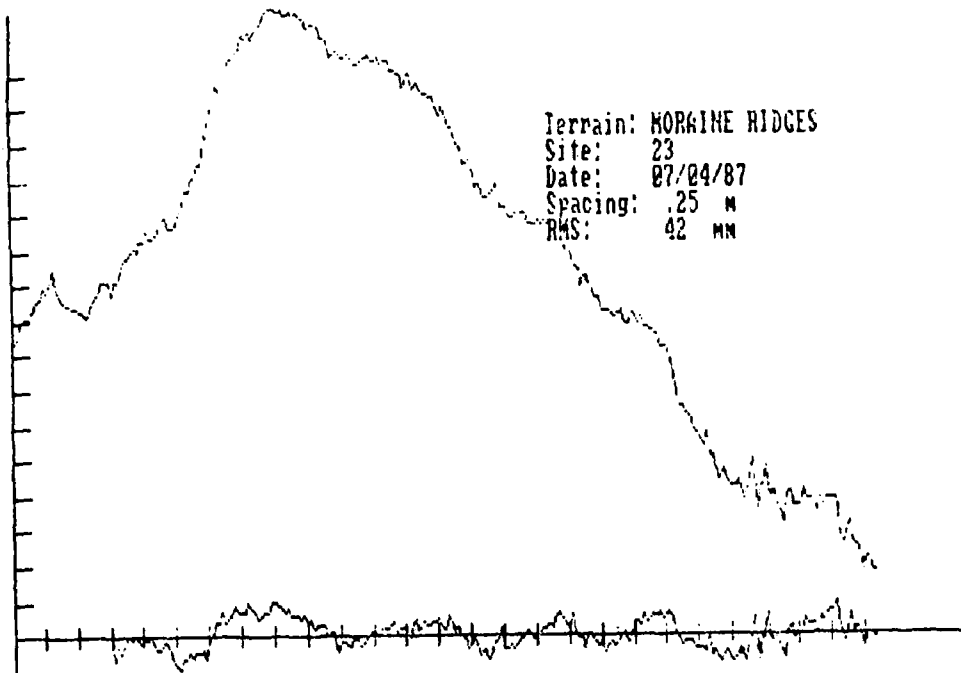
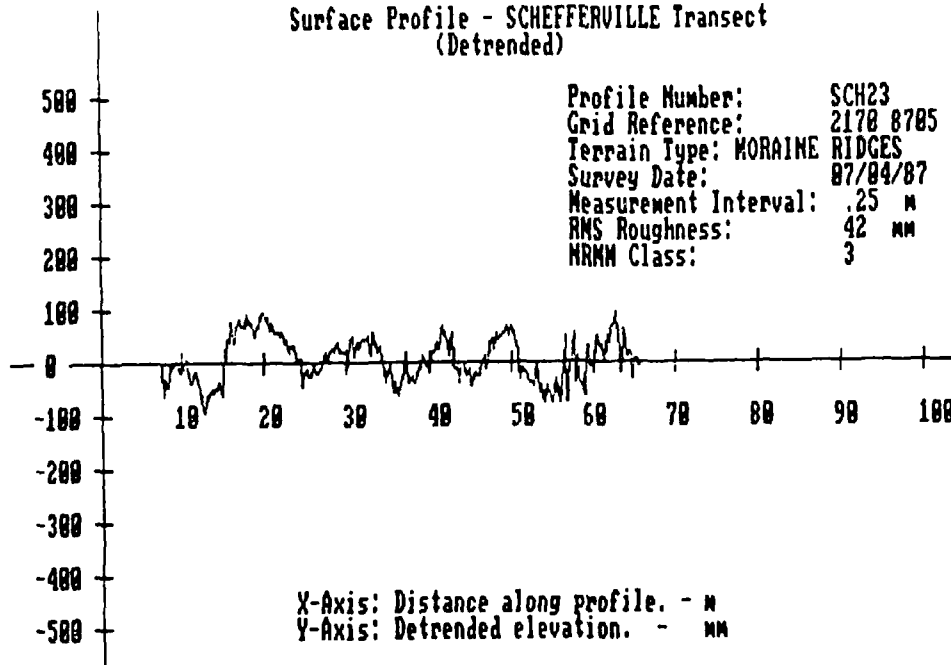


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

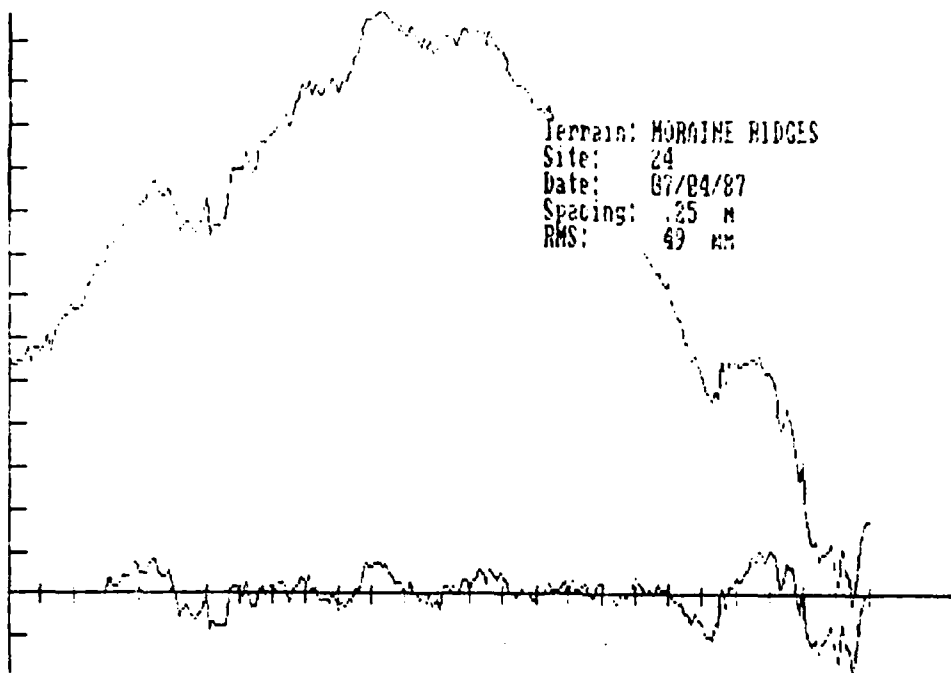
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

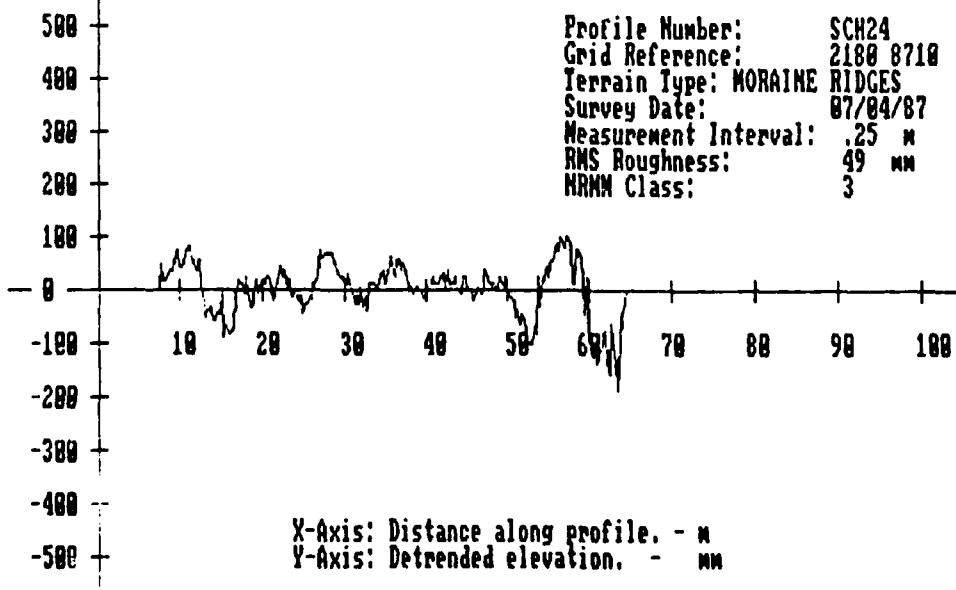
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/A-25

(Raw Data)

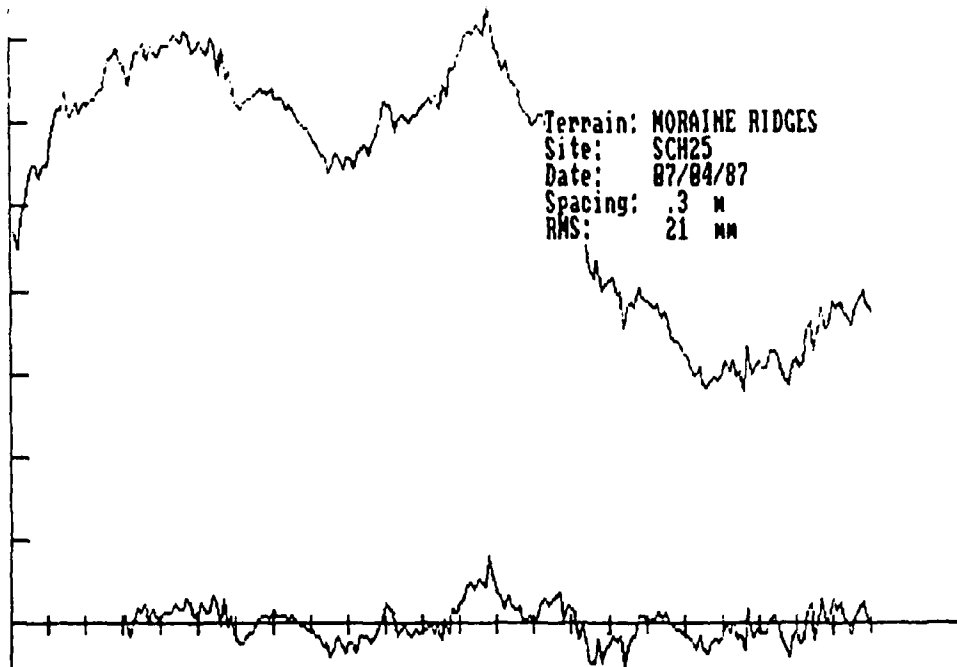
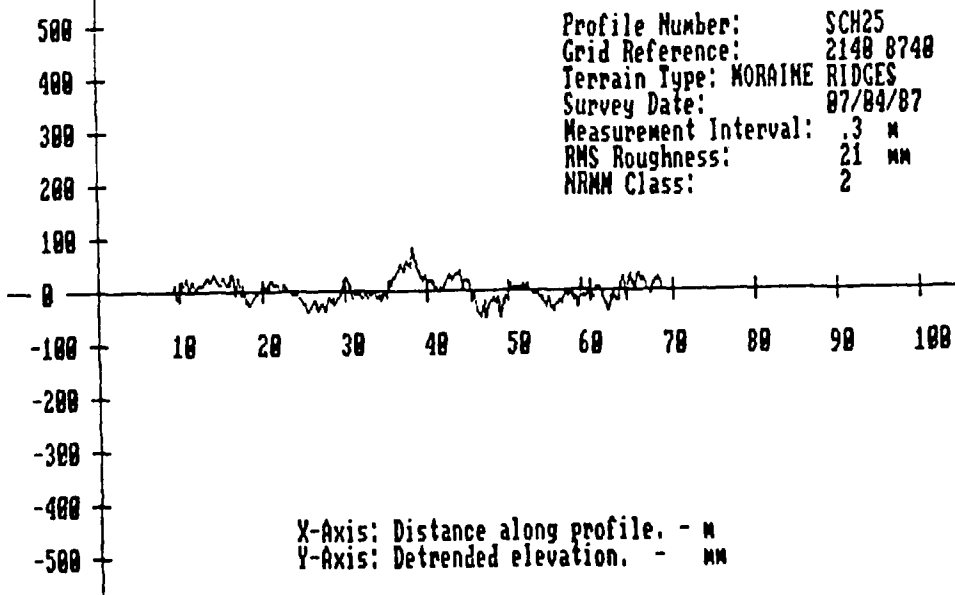


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

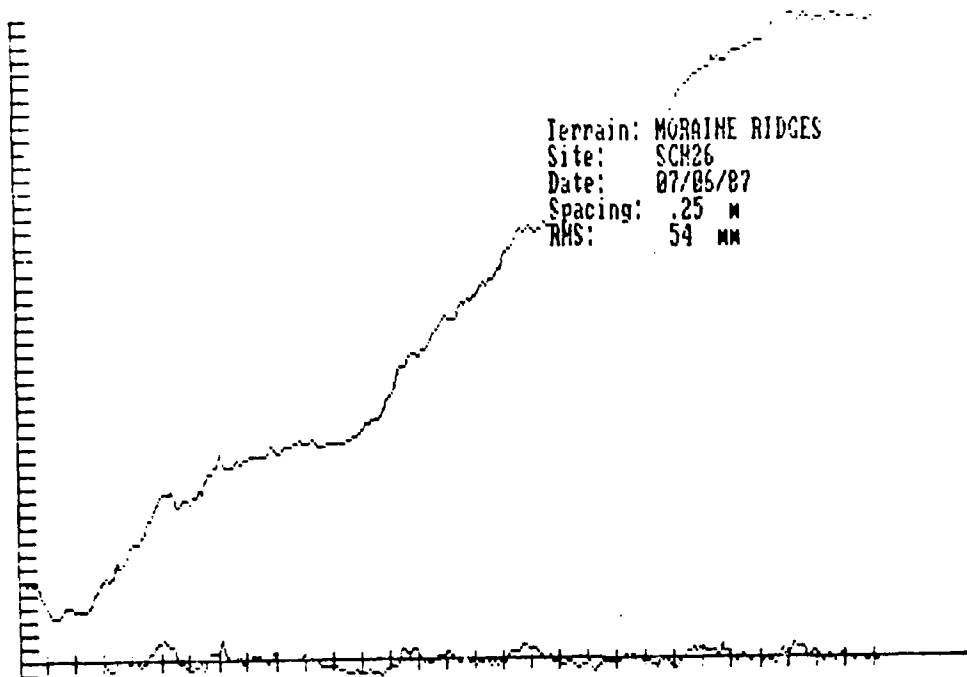
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

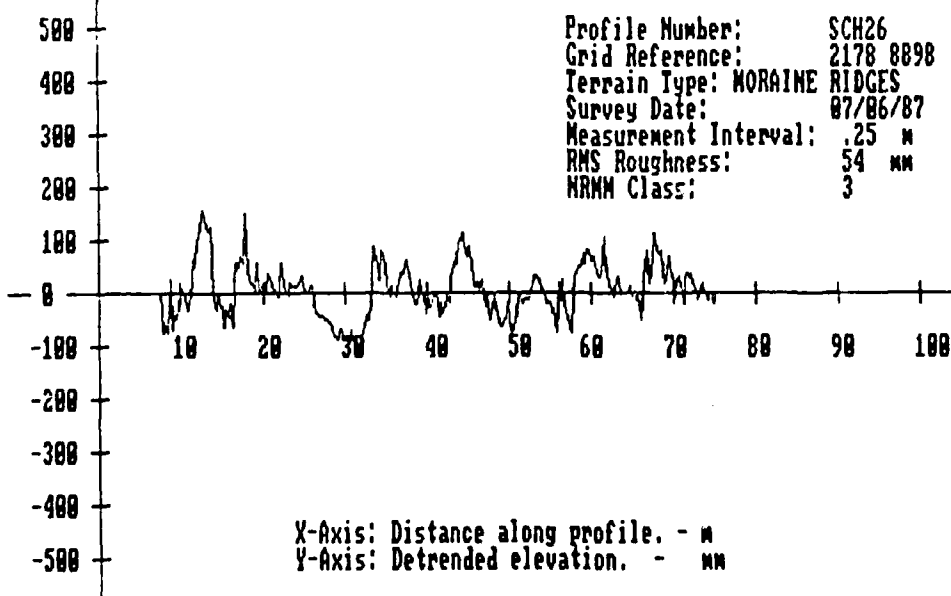
UNCLASSIFIED

/A-27

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

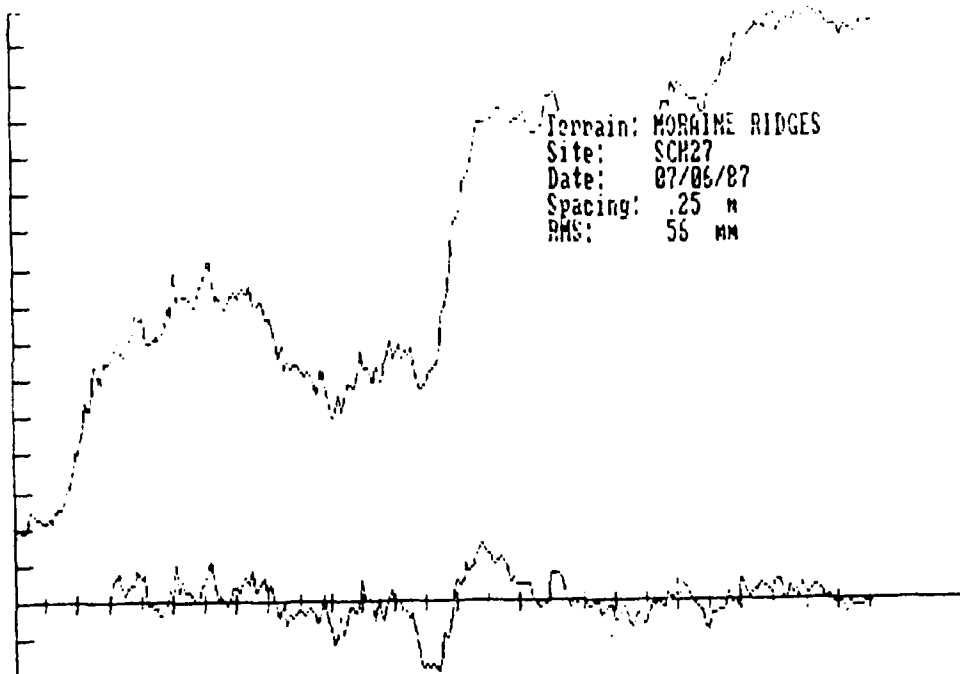


UNCLASSIFIED

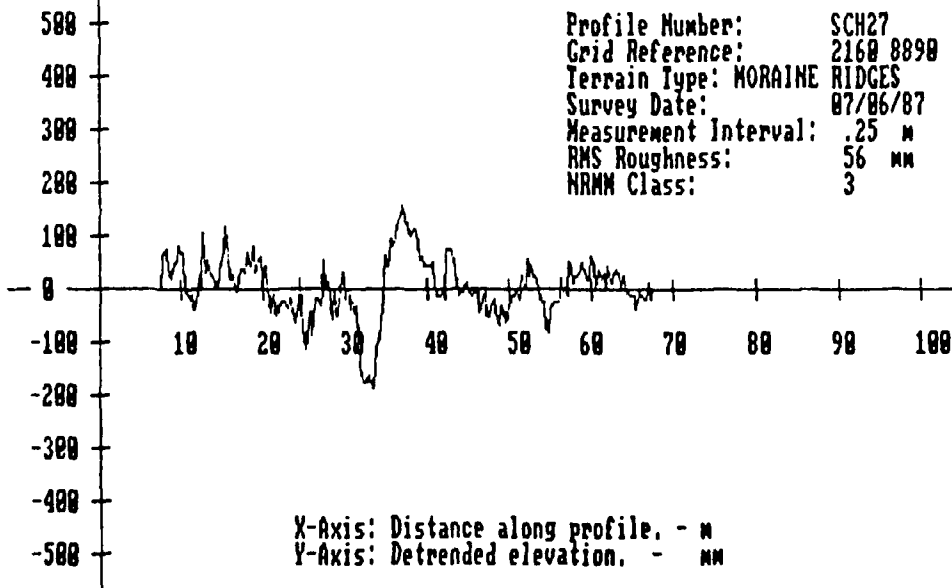
UNCLASSIFIED

/A-28

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

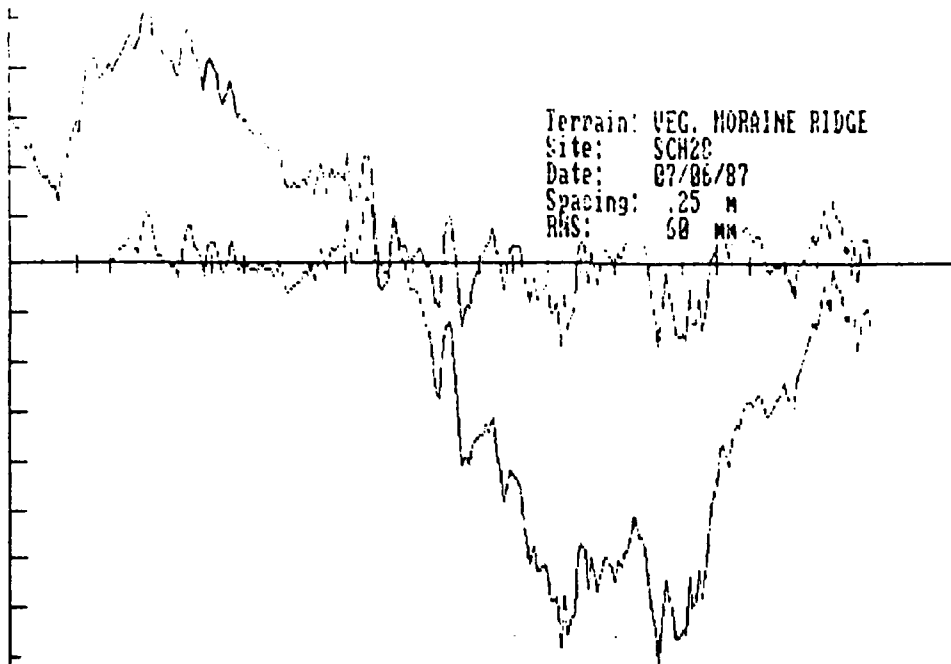


UNCLASSIFIED

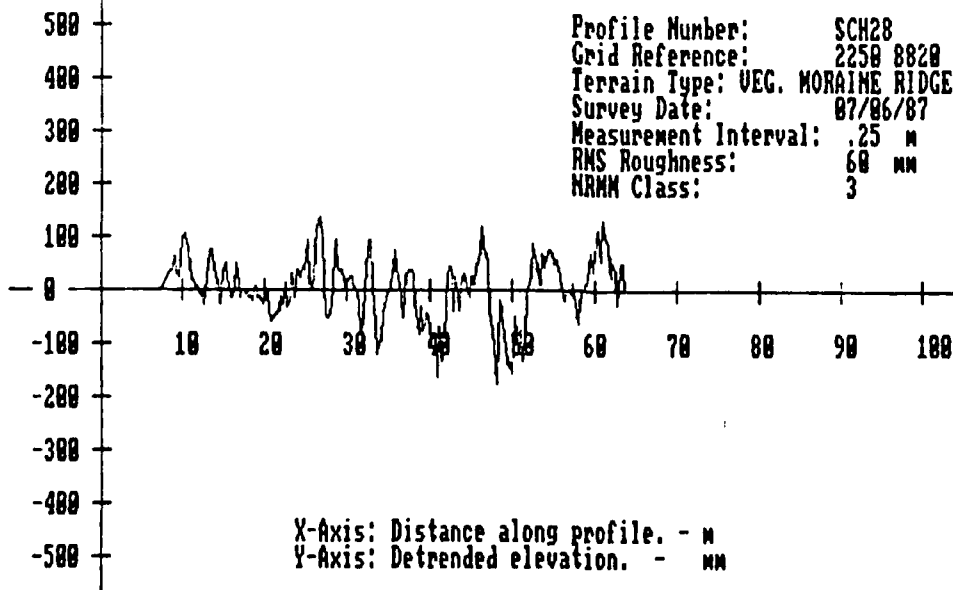
UNCLASSIFIED

/A-29

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

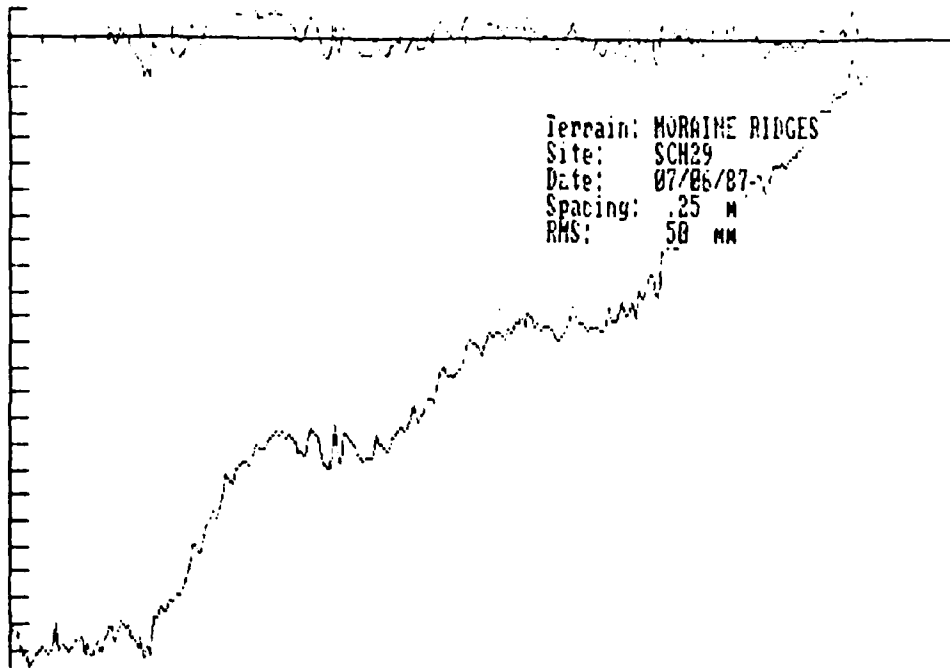


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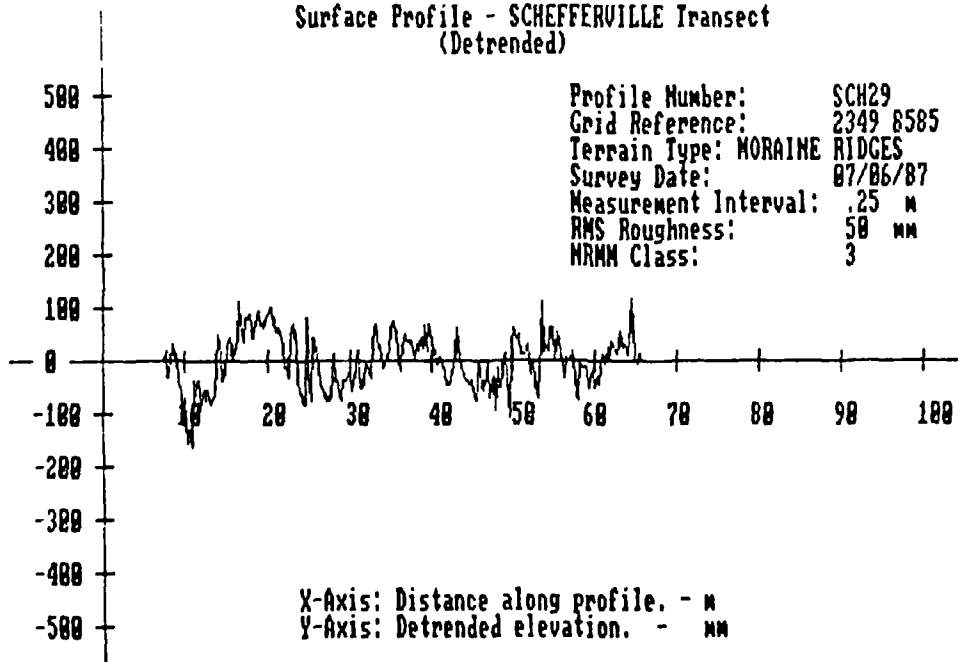
UNCLASSIFIED

/A-30

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

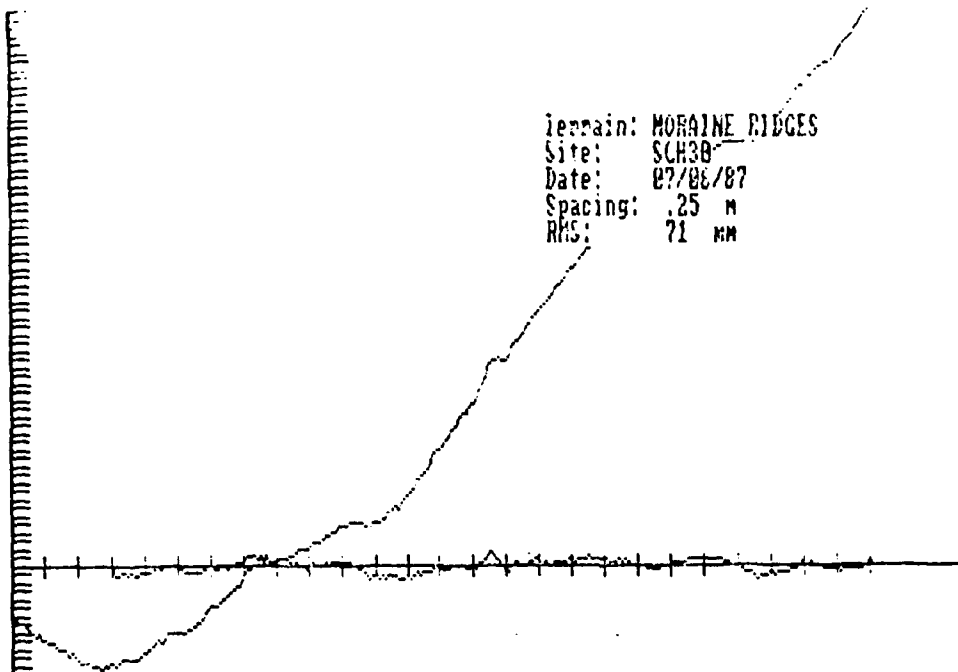


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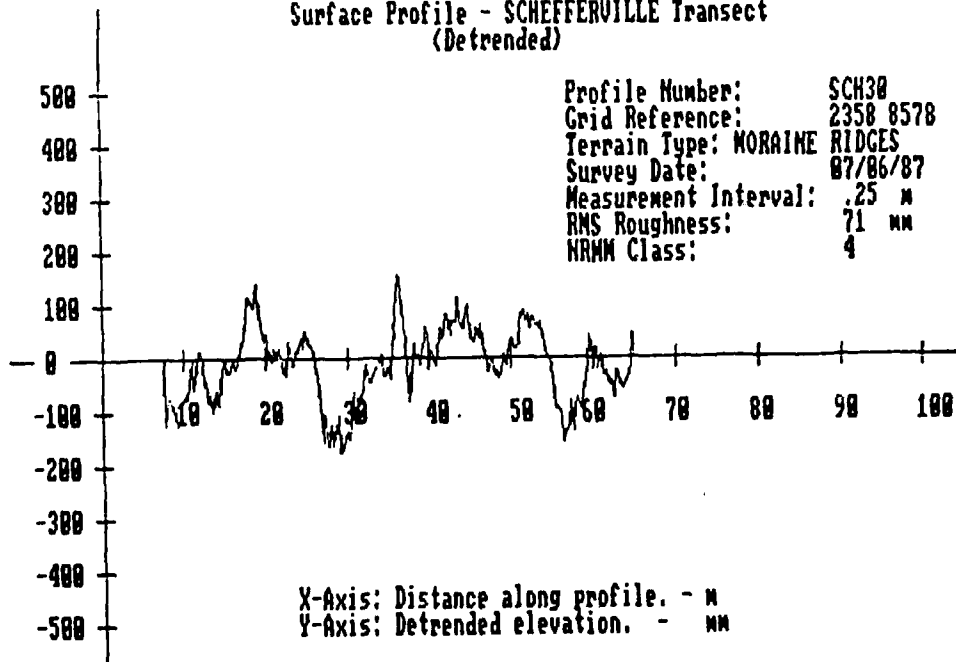
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/A-31

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

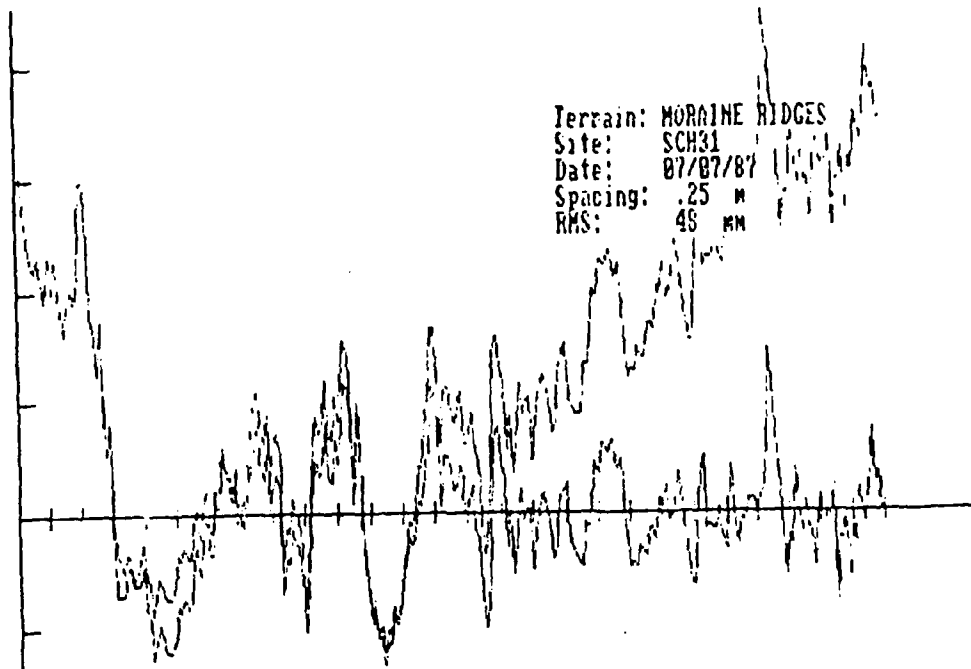


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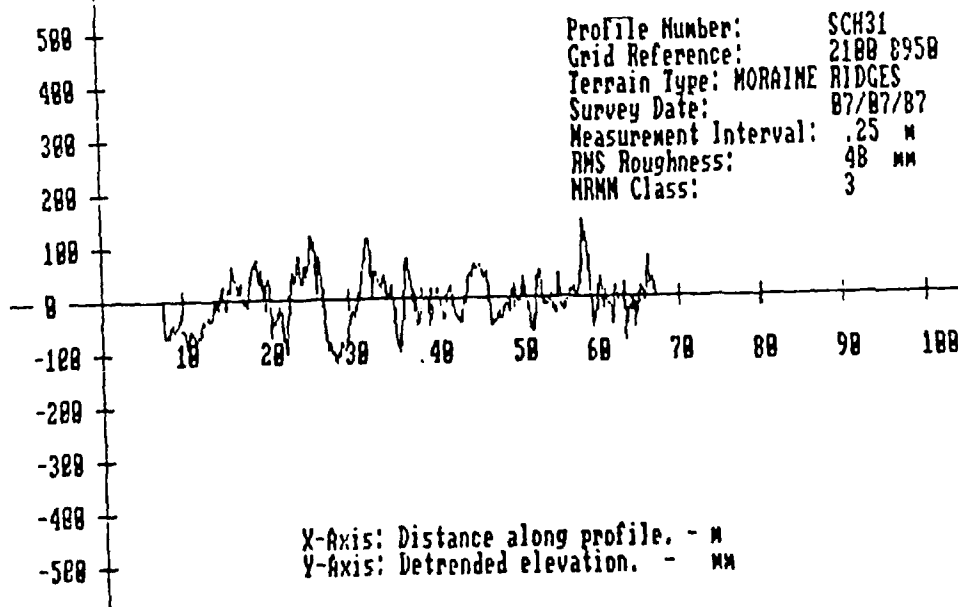
UNCLASSIFIED

/A-32

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

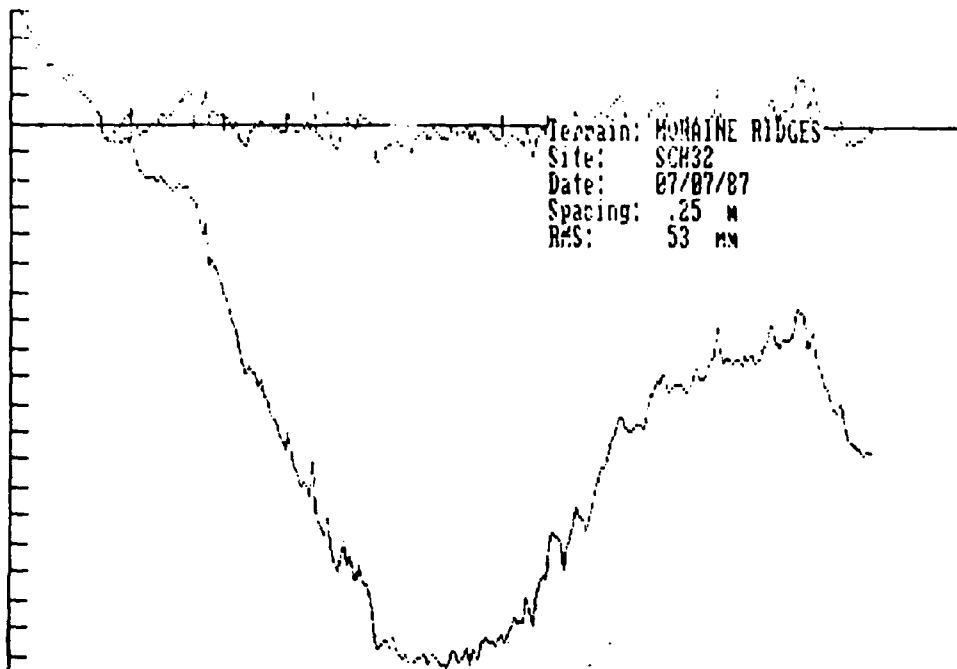


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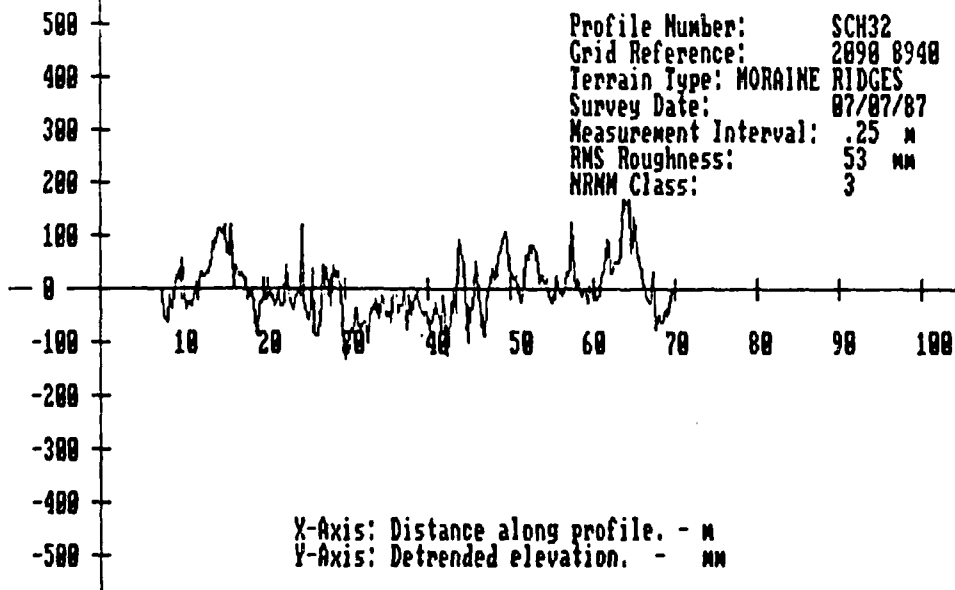
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/A-33

(Raw Data)

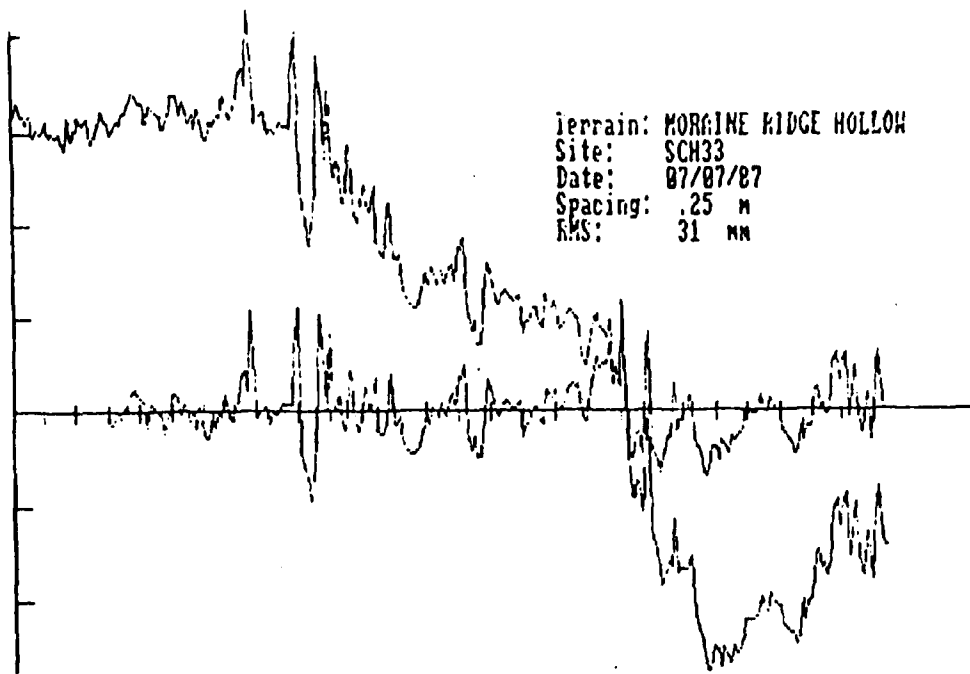
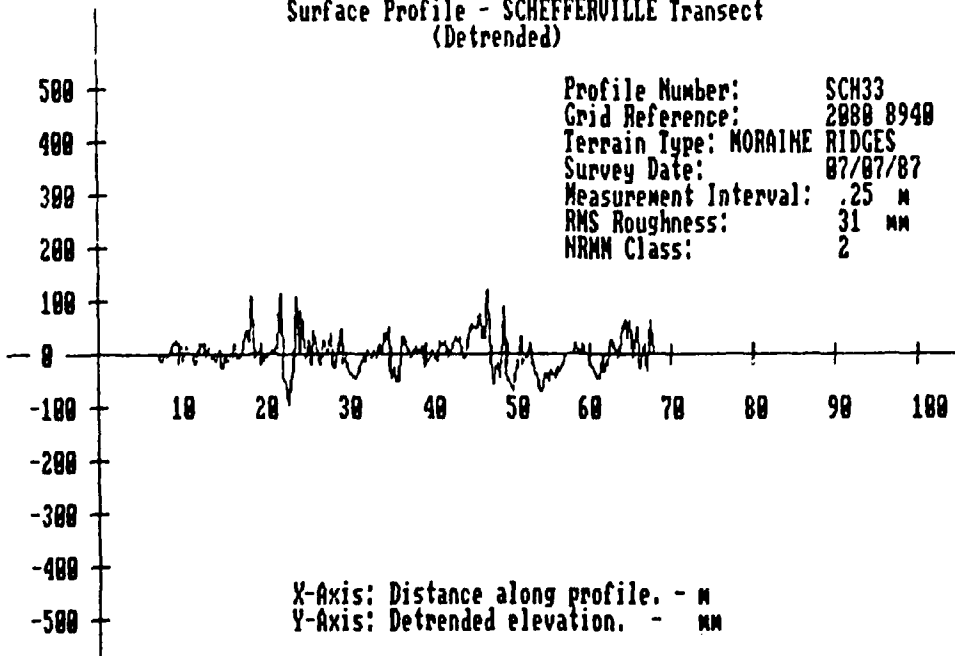


Surface Profile - SCHEFFERVILLE Transect
(Detrended)

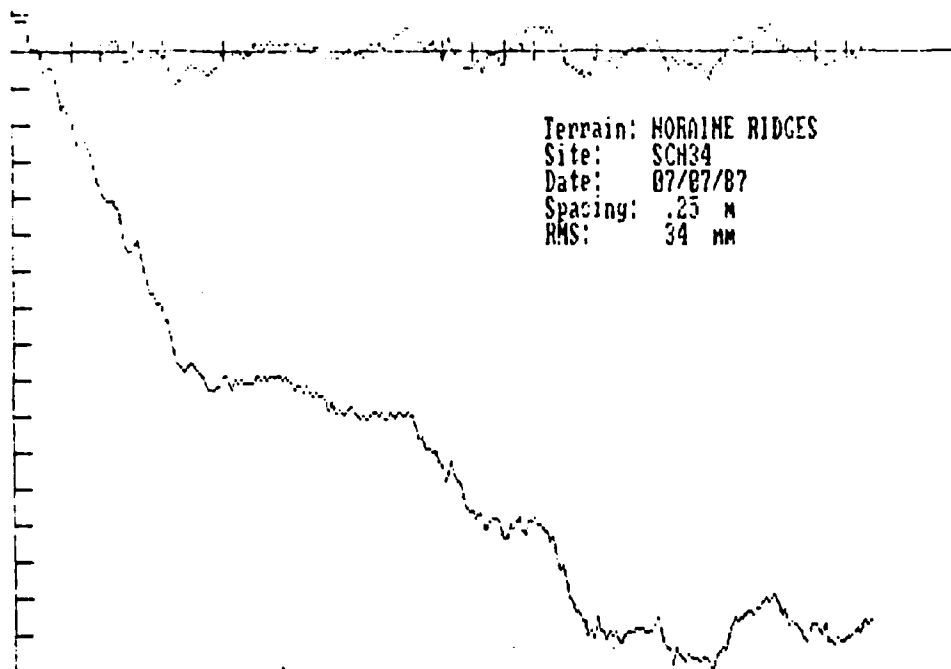
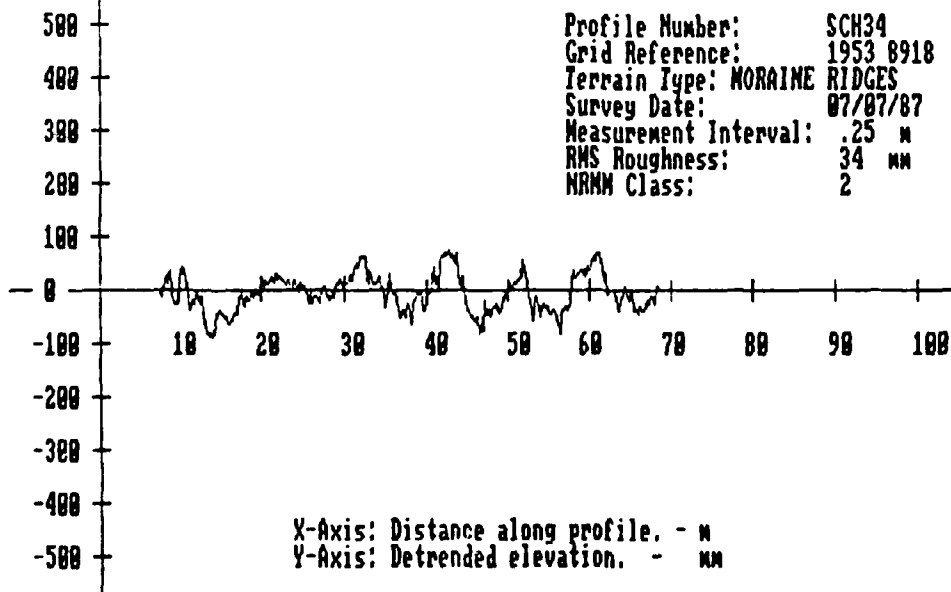


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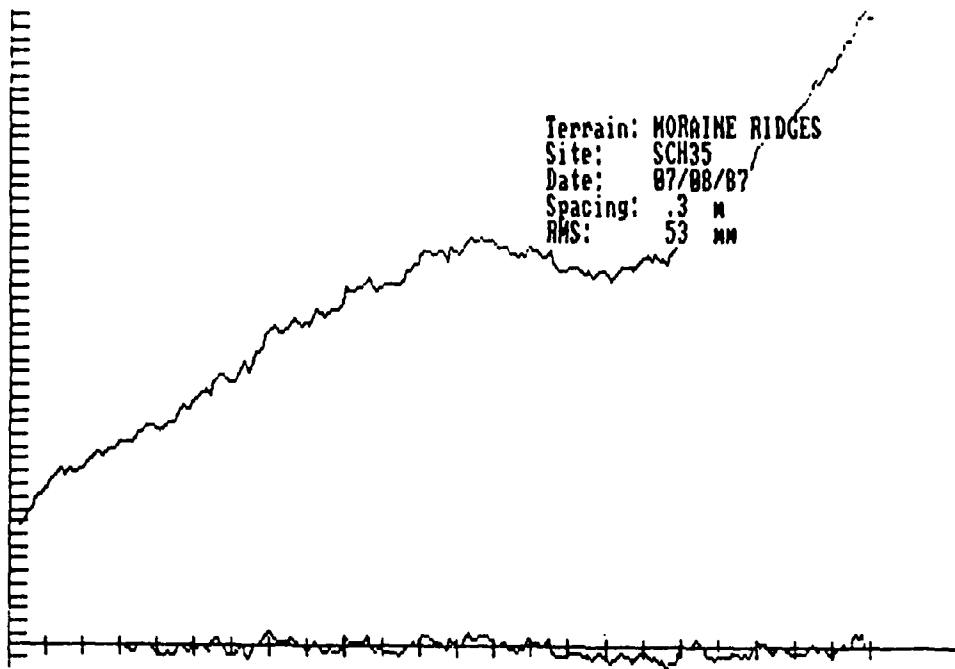
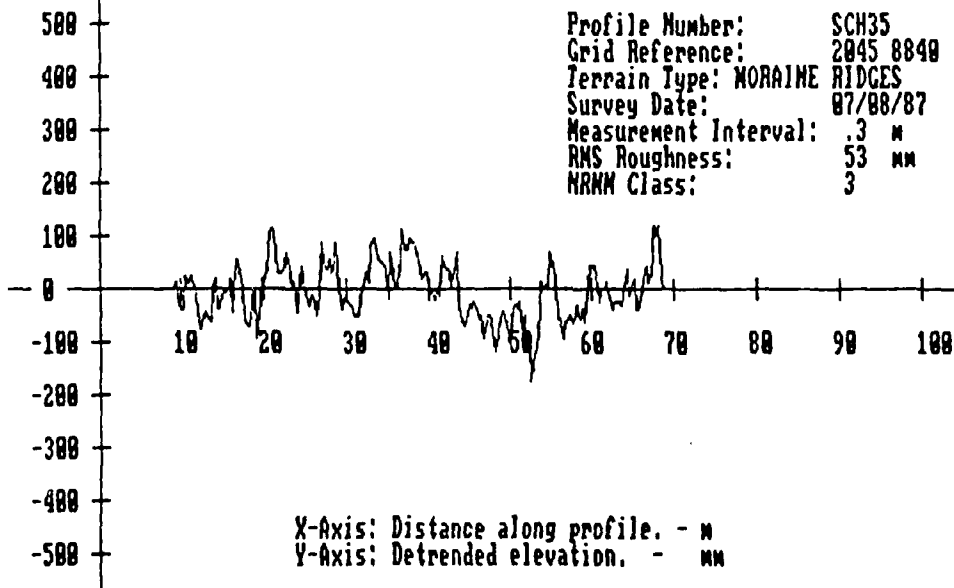
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

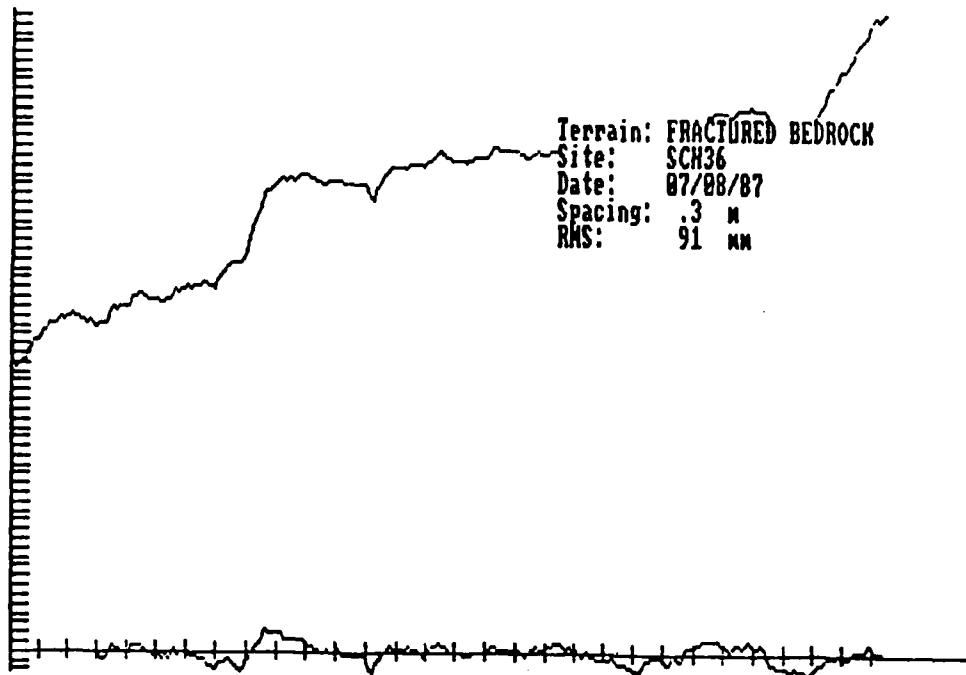
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

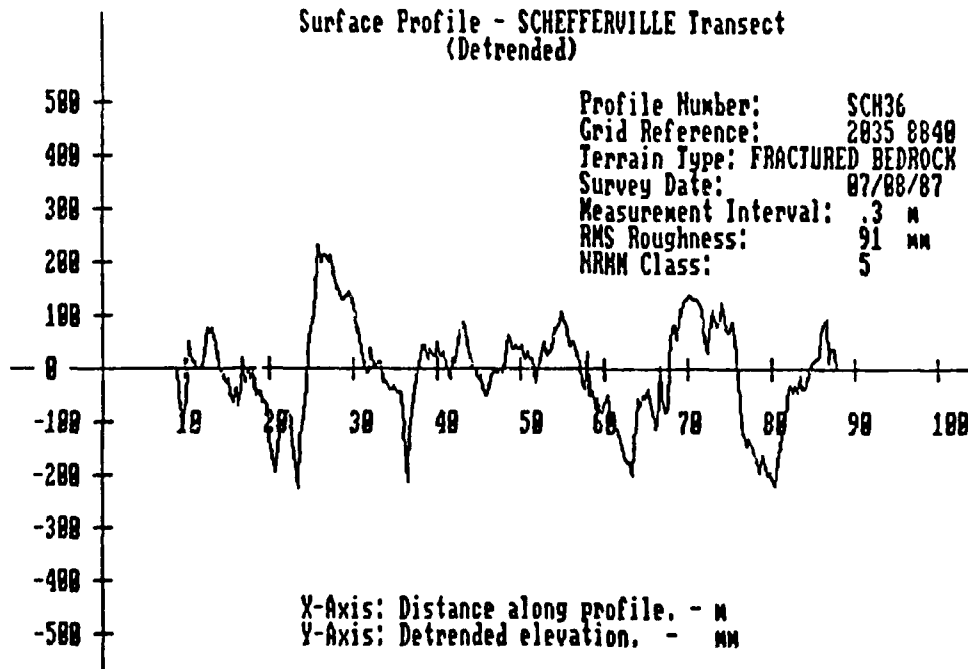
UNCLASSIFIED

/A-37

(Raw Data)

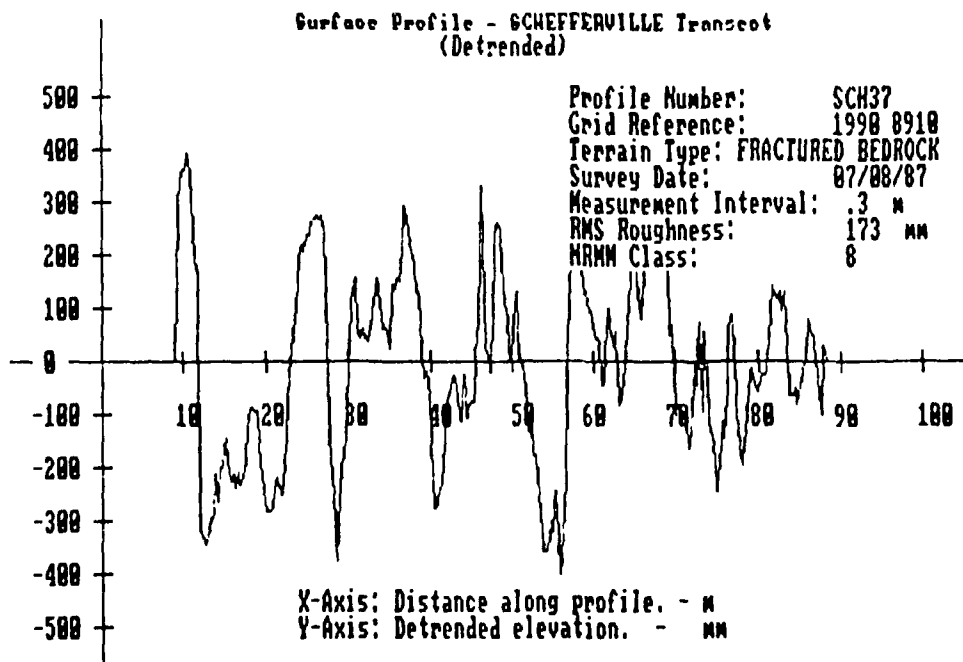
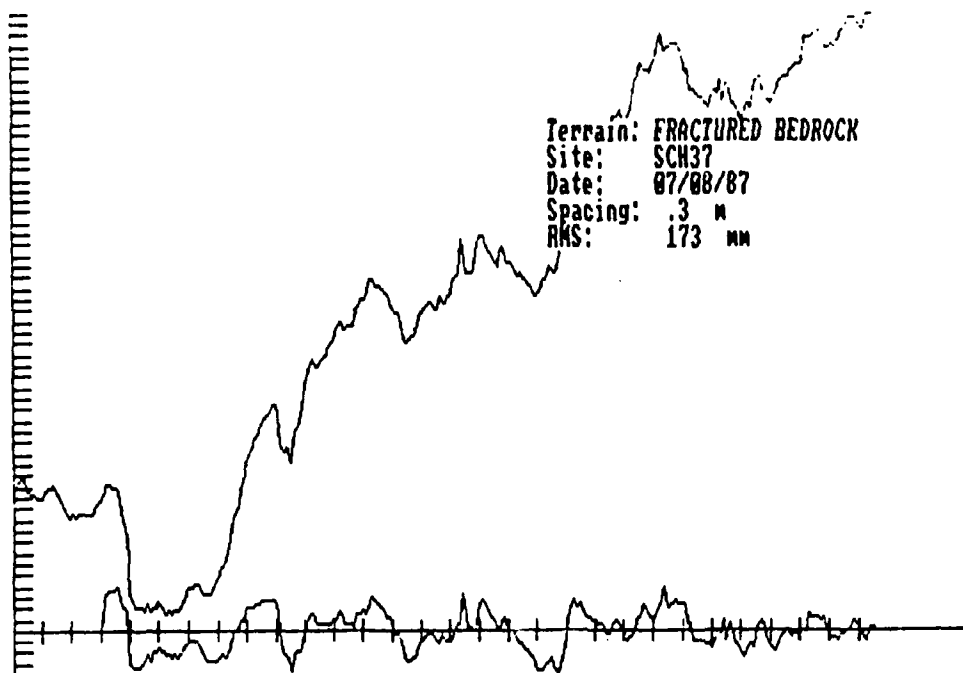


Surface Profile - SCHEFFERVILLE Transect
(Detrended)

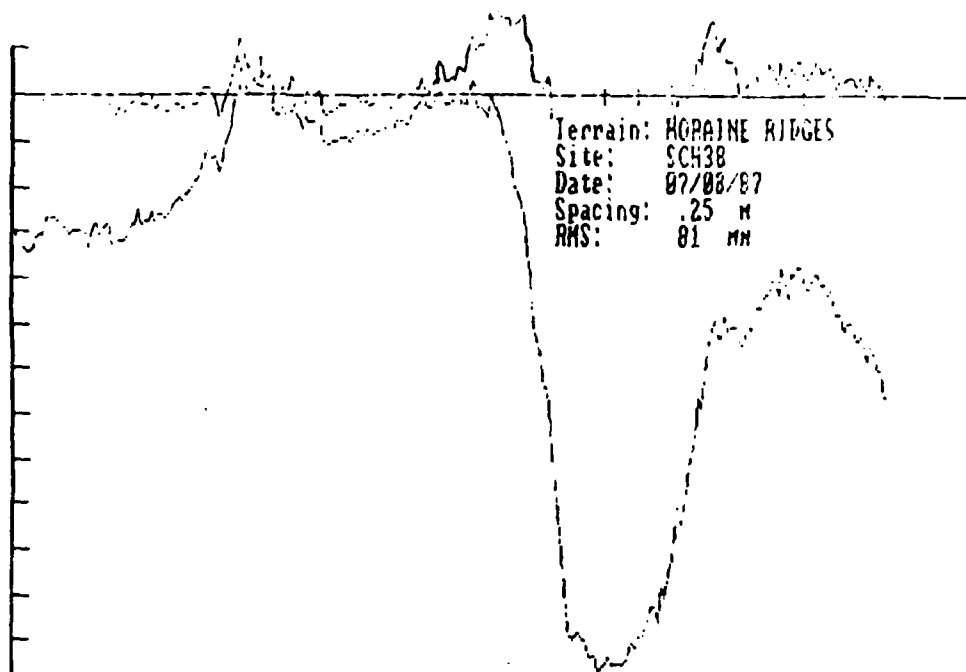
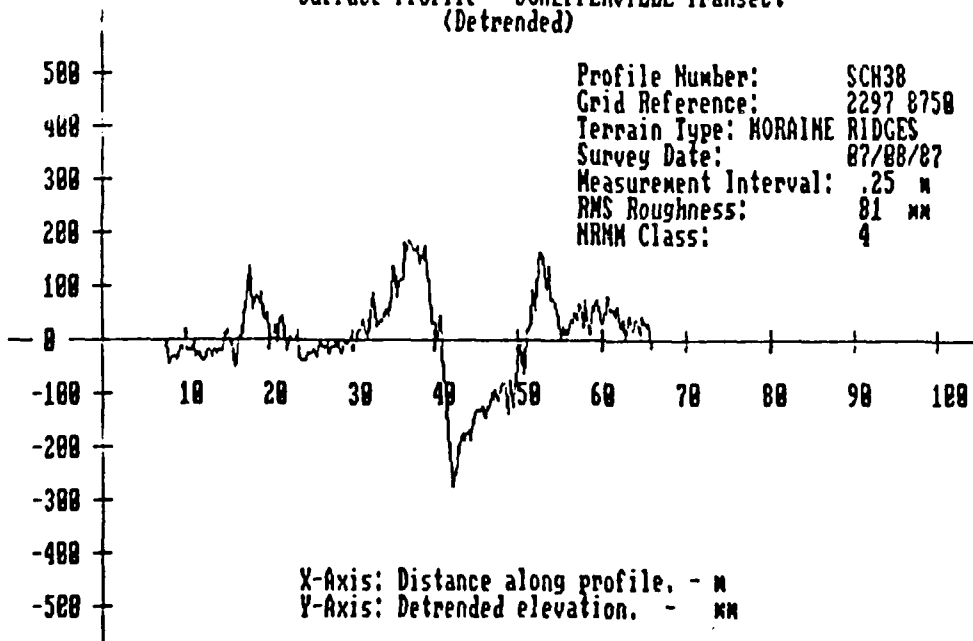


UNCLASSIFIED

(Raw Data)



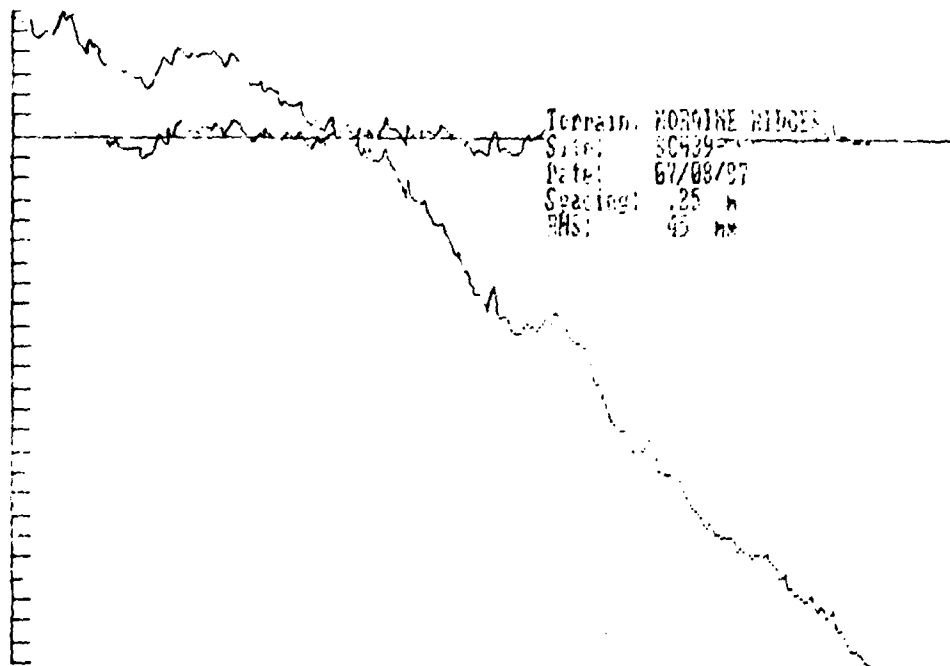
(Raw Data)

Surface Profile - SCHEFFERVILLE Transect
(Detrended)

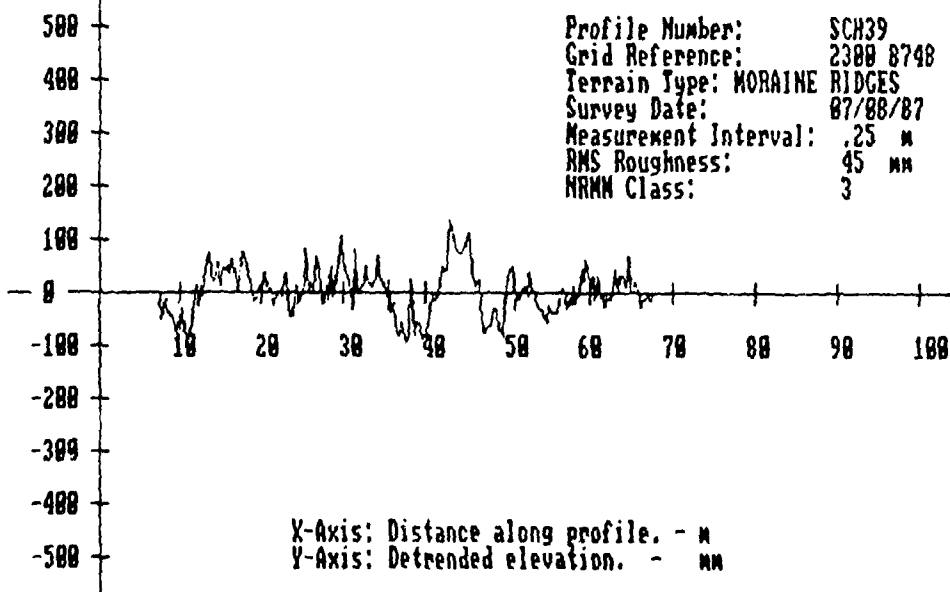
UNCLASSIFIED

/A-40

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

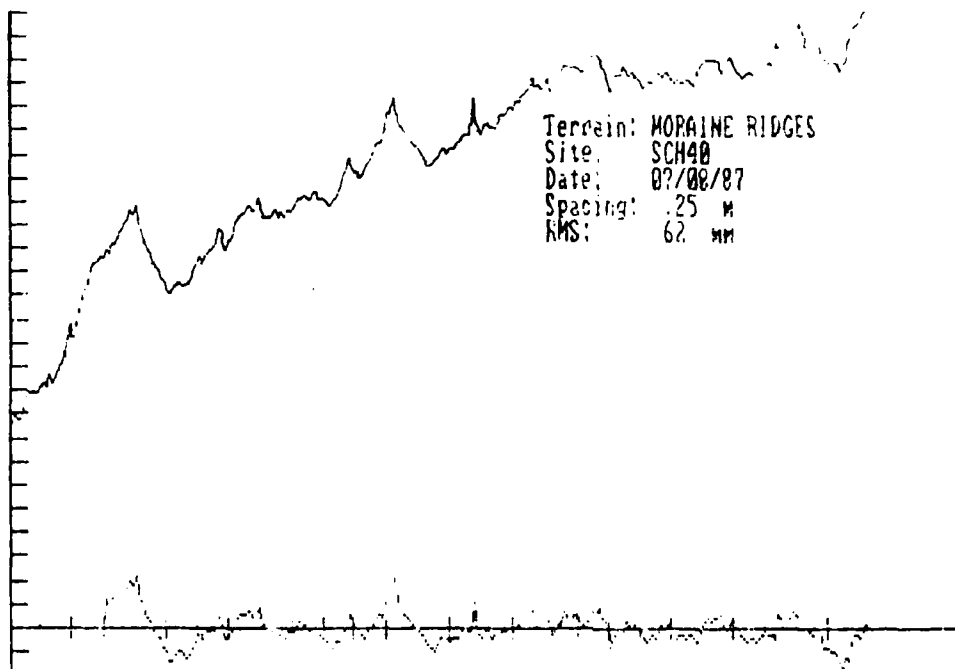


UNCLASSIFIED

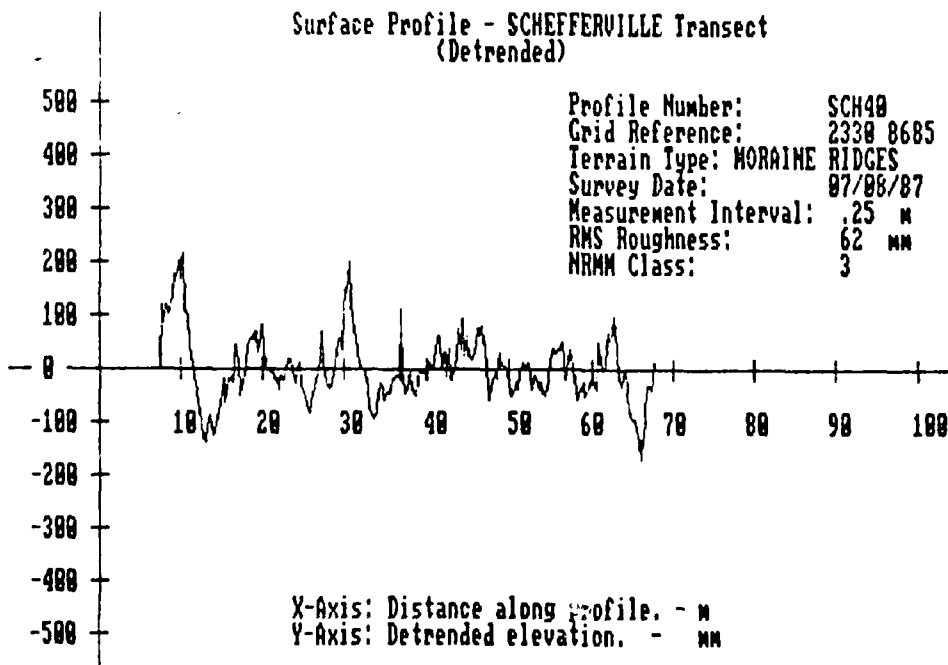
UNCLASSIFIED

/A-41

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

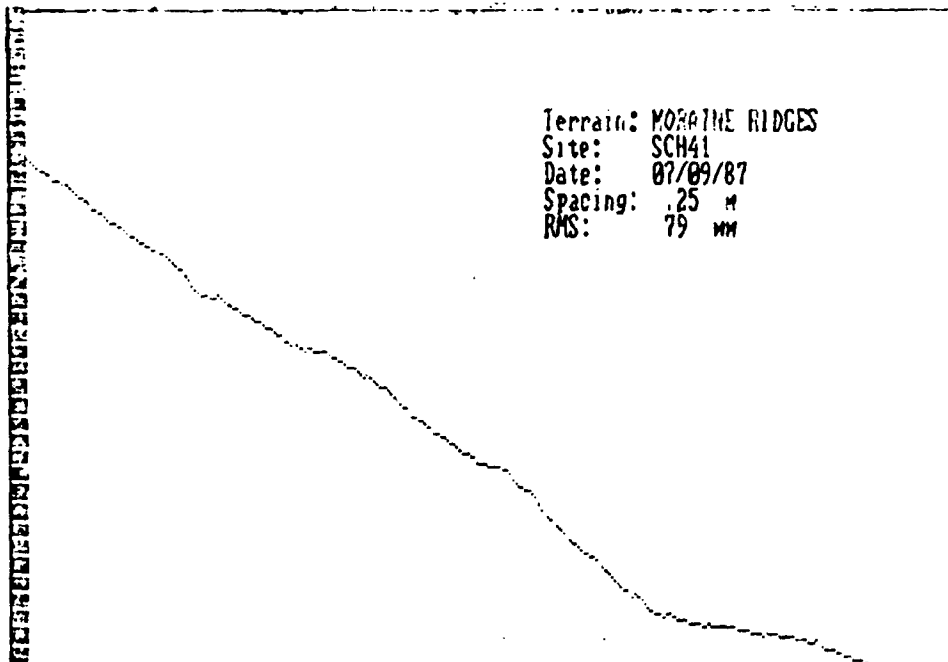


UNCLASSIFIED

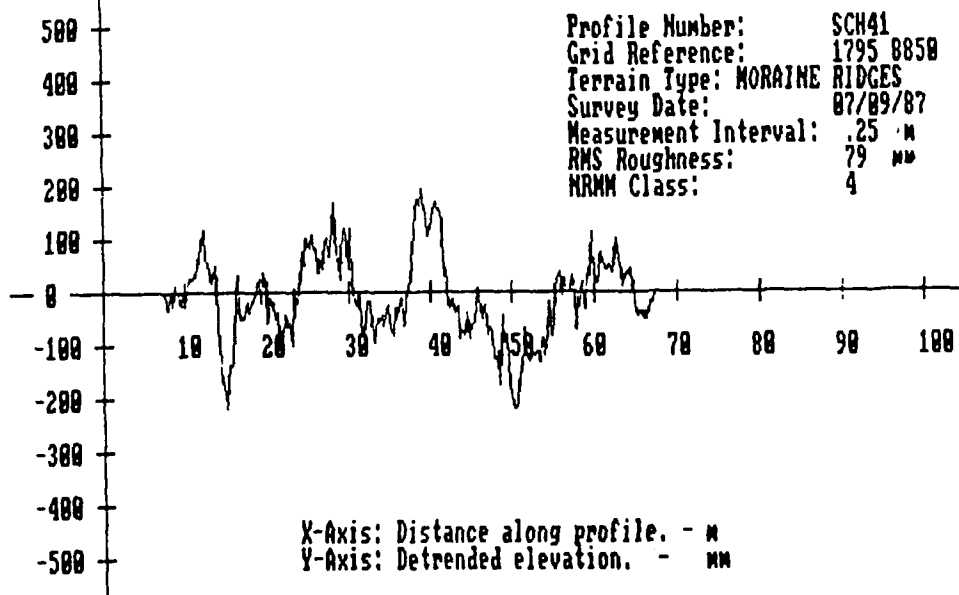
UNCLASSIFIED

/A-42

(Raw Data)

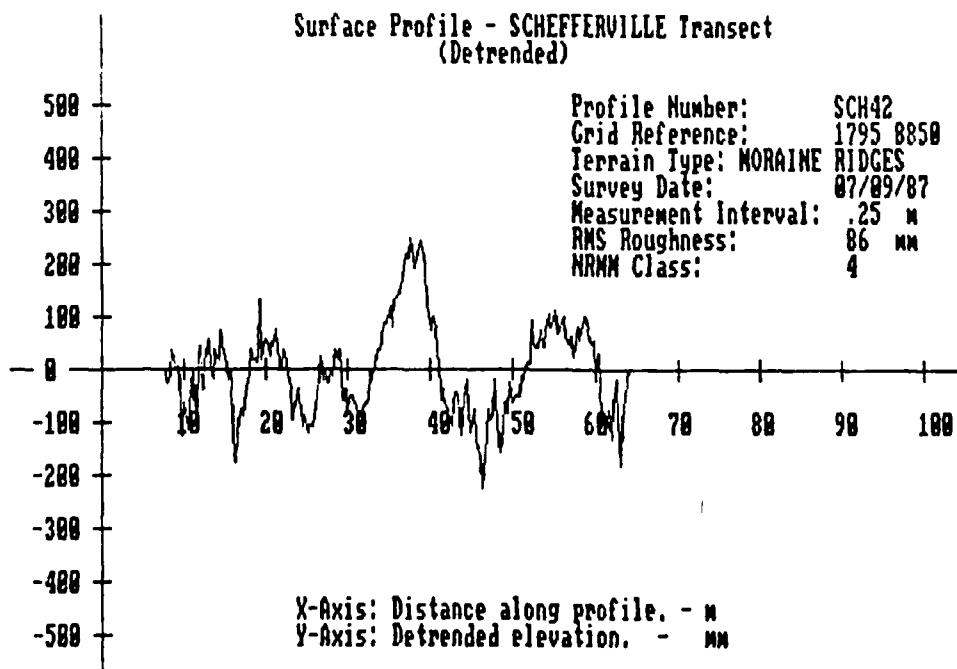
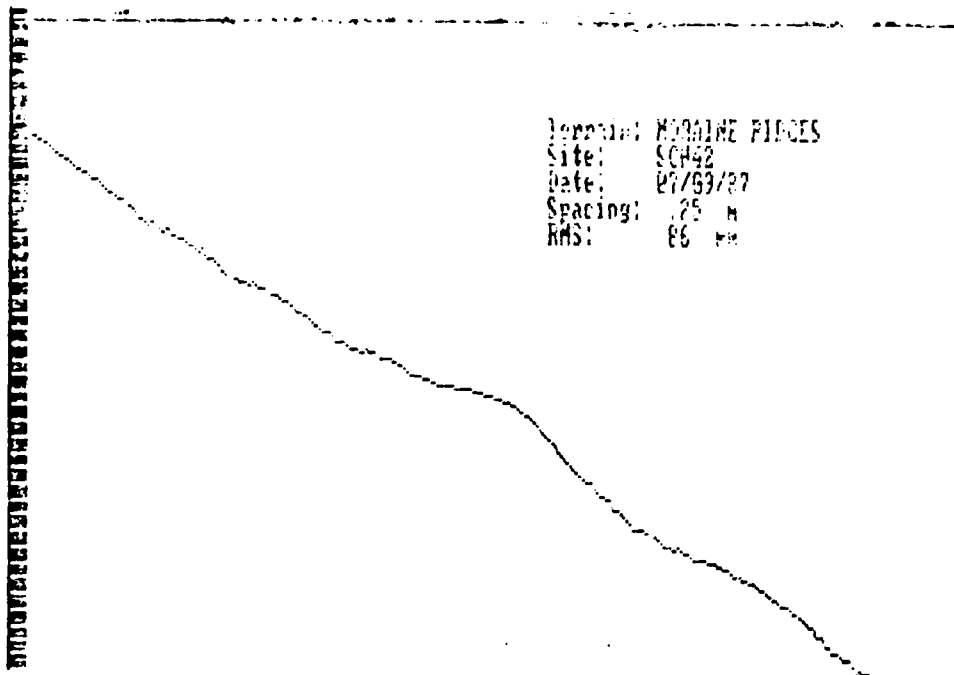


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



UNCLASSIFIED

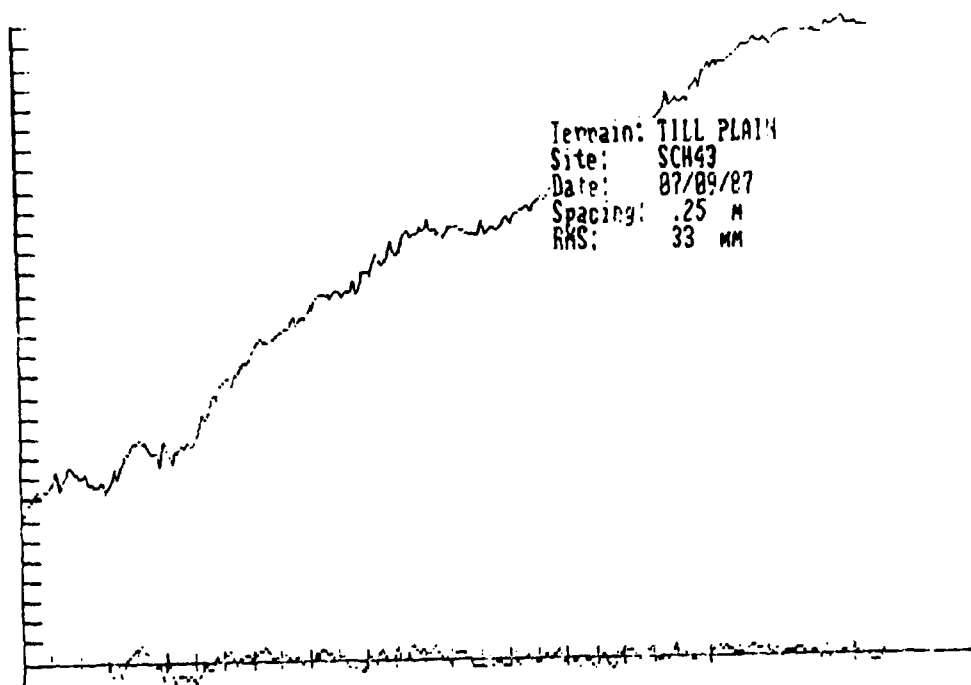
(Raw Data)



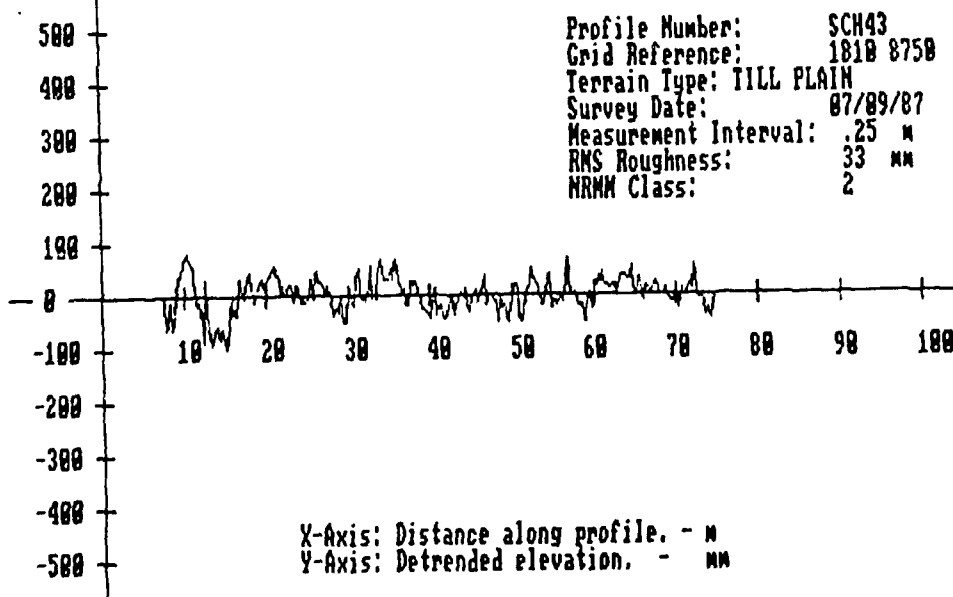
UNCLASSIFIED

/A-44

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

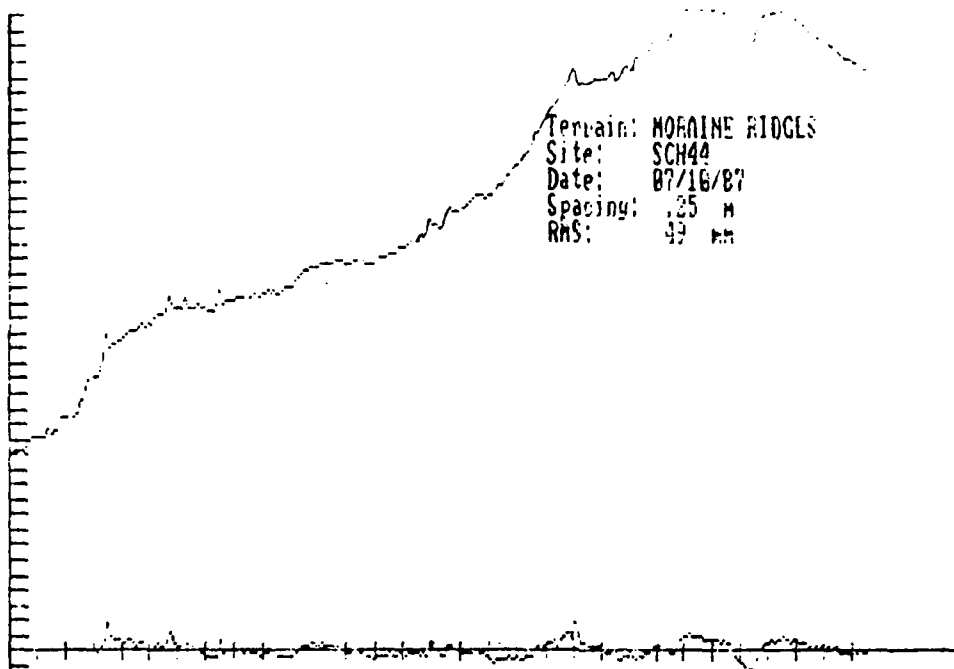


UNCLASSIFIED

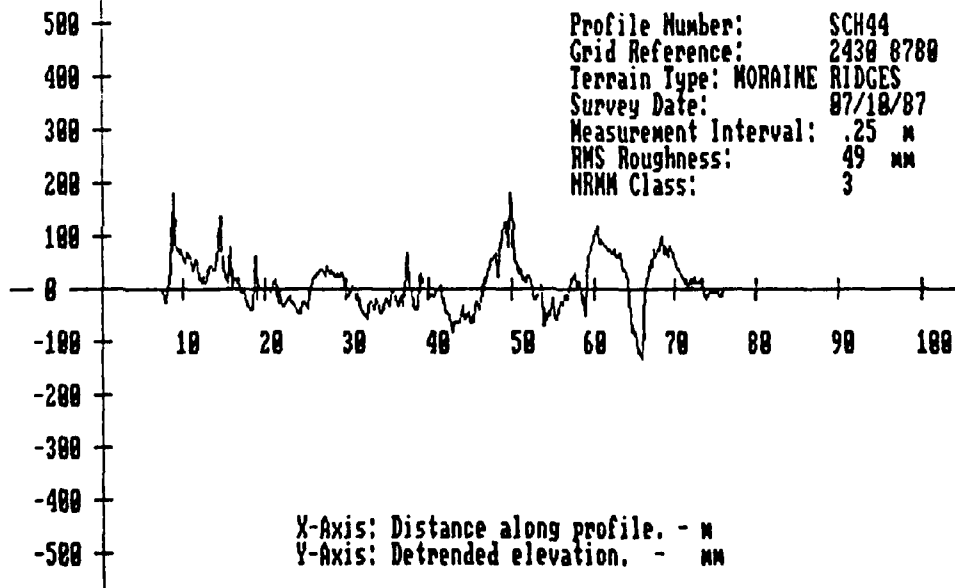
UNCLASSIFIED

/A-45

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

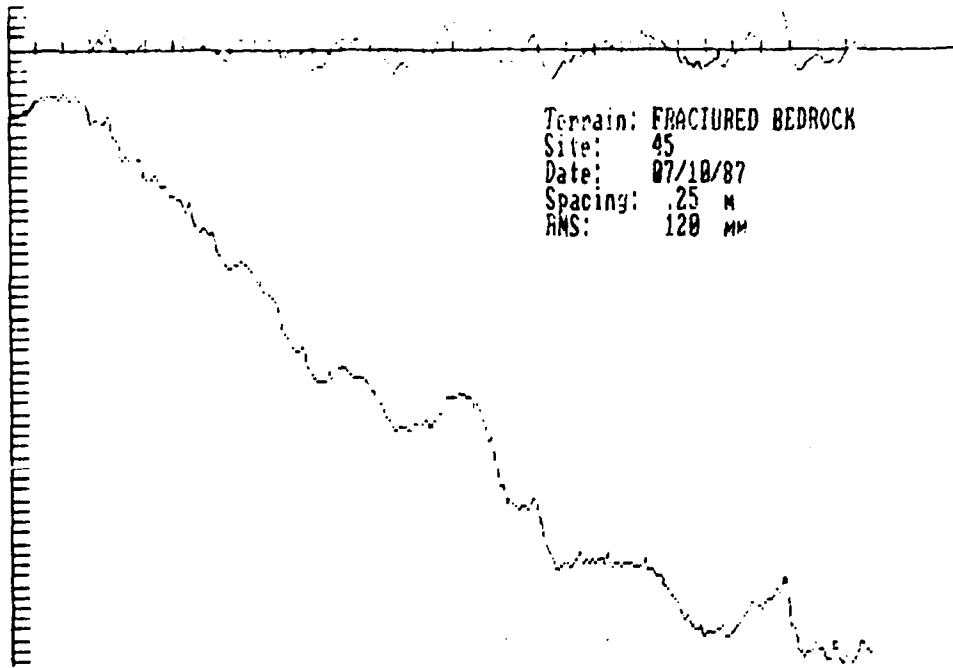


UNCLASSIFIED

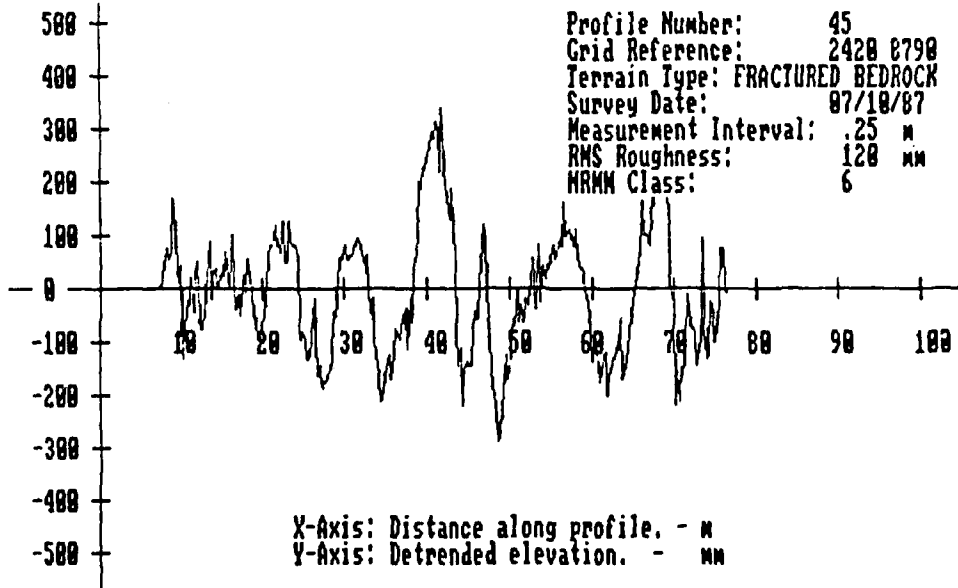
UNCLASSIFIED

/A-46

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

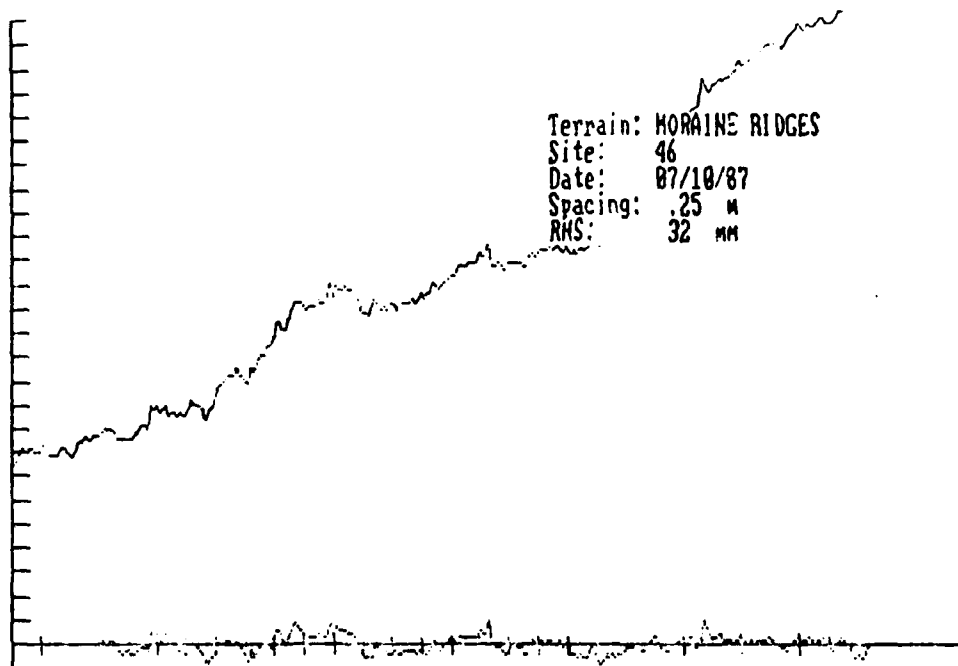


UNCLASSIFIED

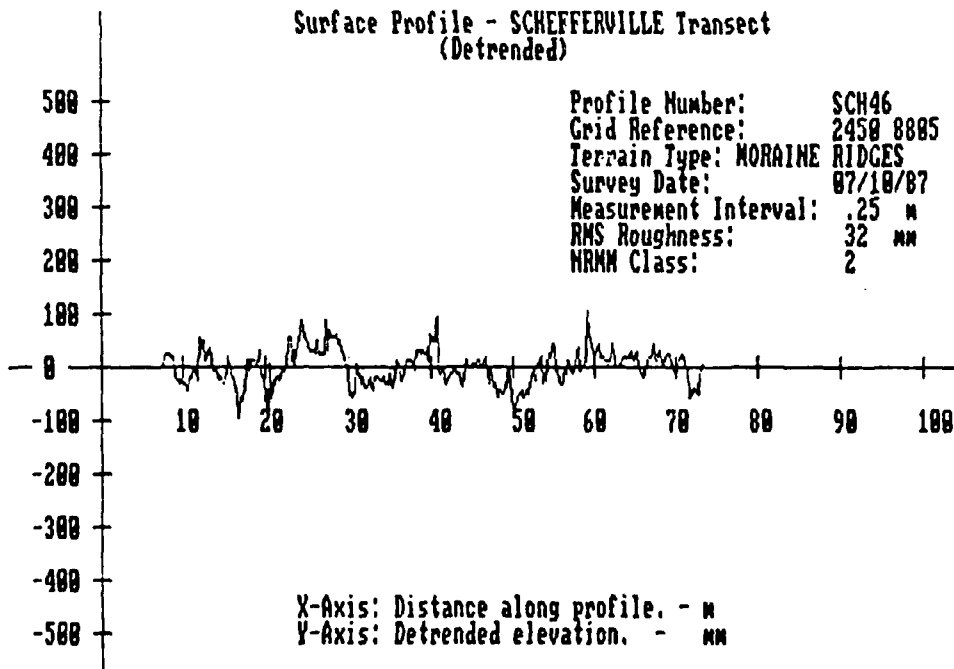
UNCLASSIFIED

/A-47

(Raw Data)

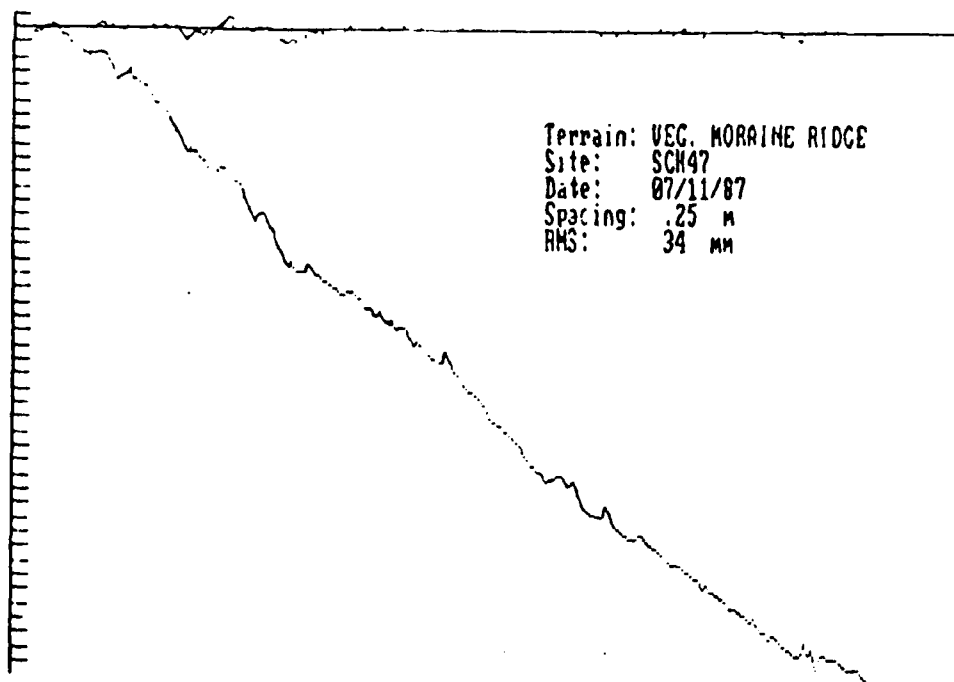
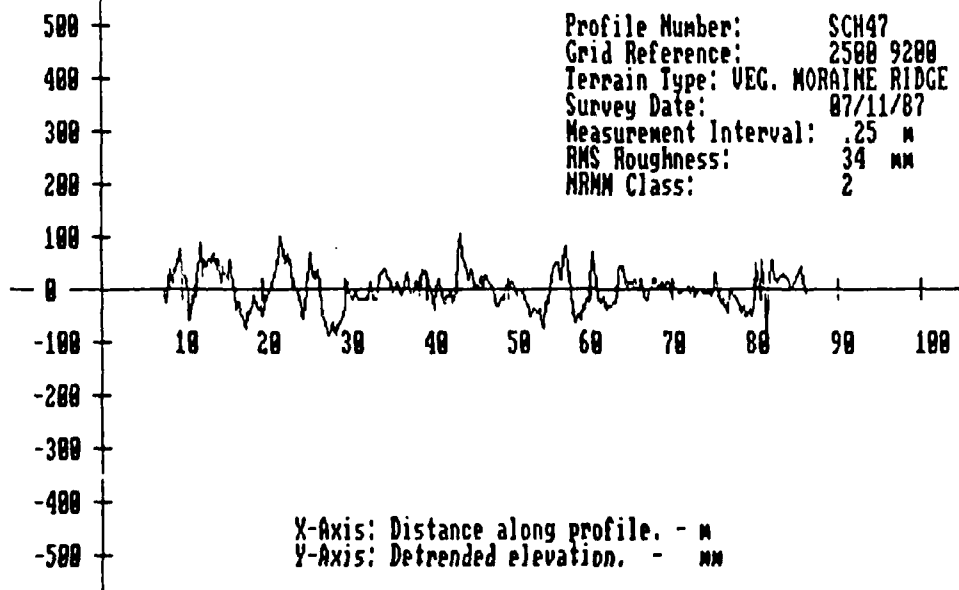


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



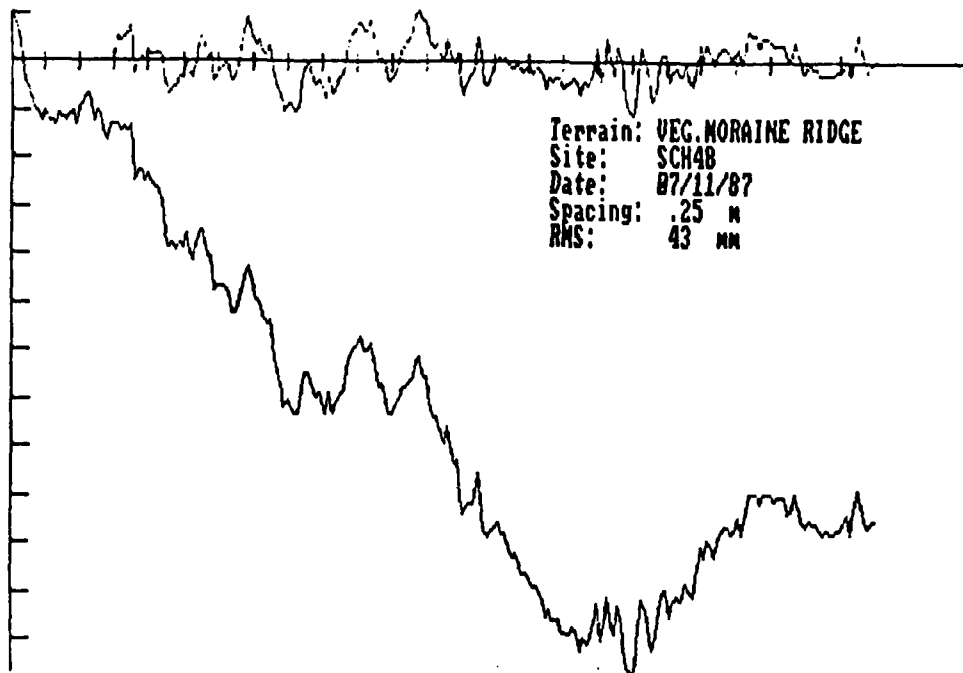
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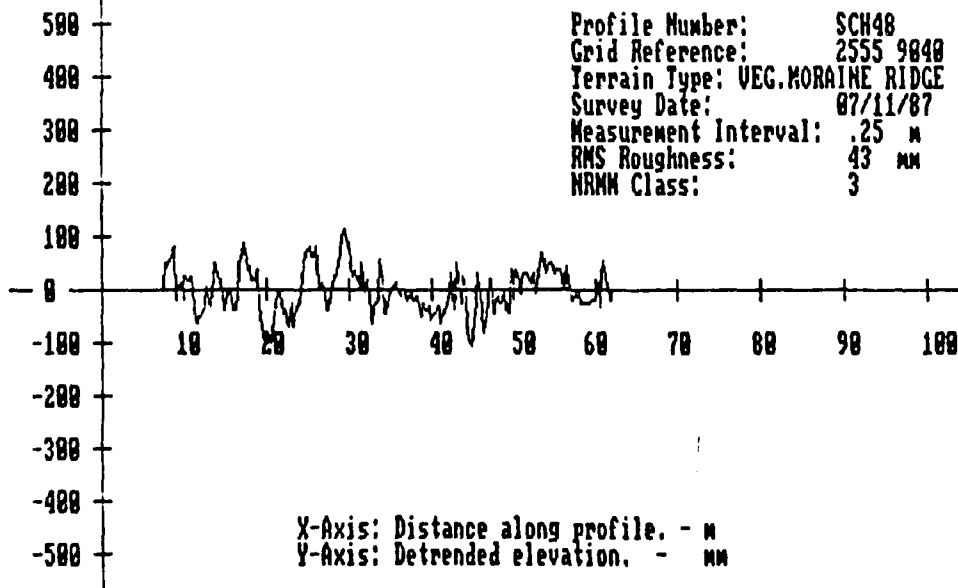
Surface Profile - SCHEFFERVILLE Transect
(Detrended)

UNCLASSIFIED
(Raw Data)

/A-49



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

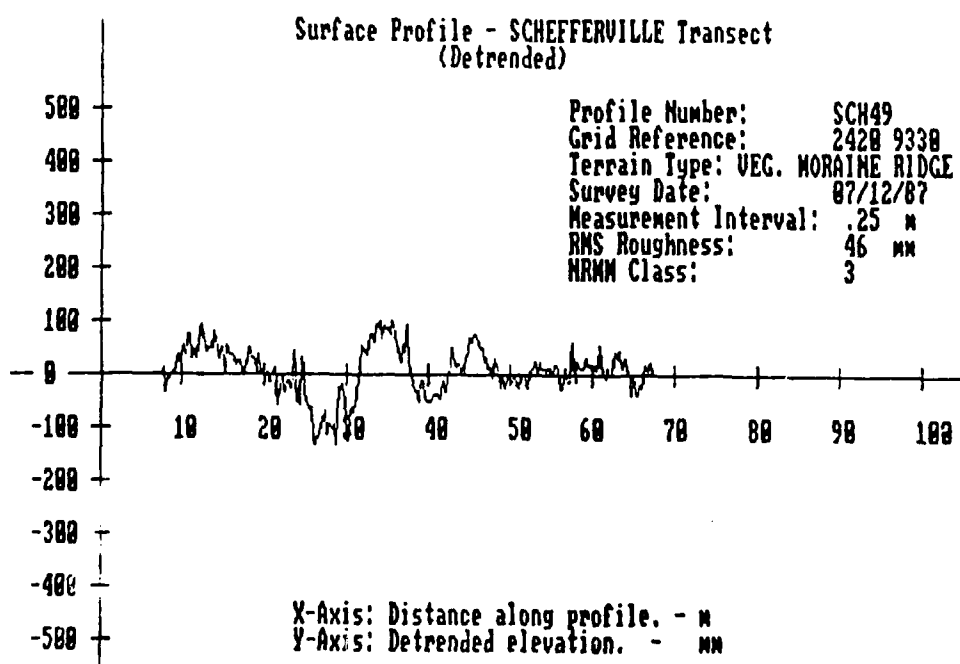
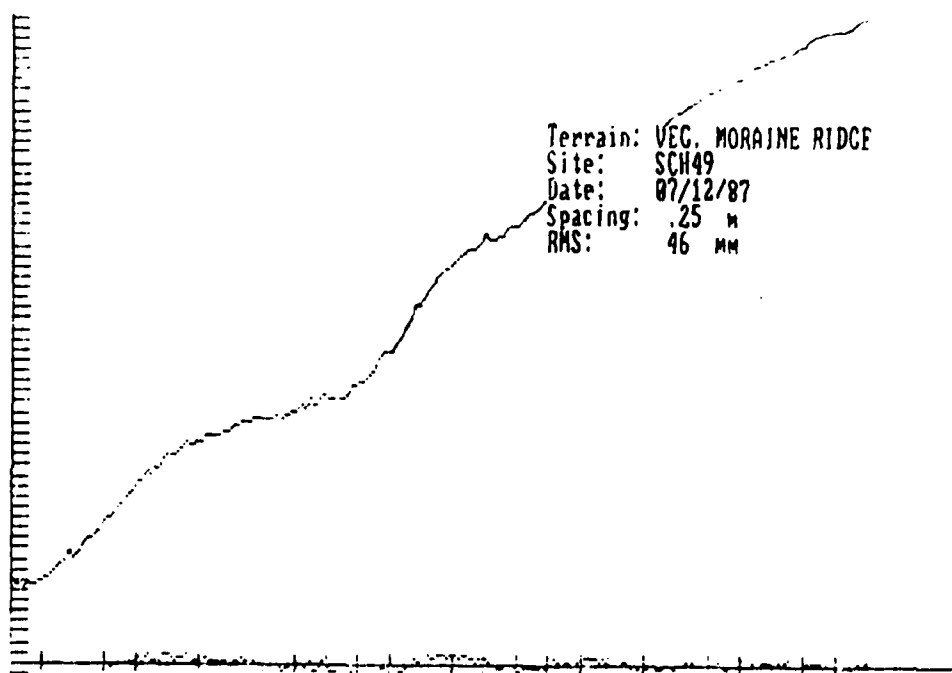


UNCLASSIFIED

UNCLASSIFIED

/A-50

(Raw Data)

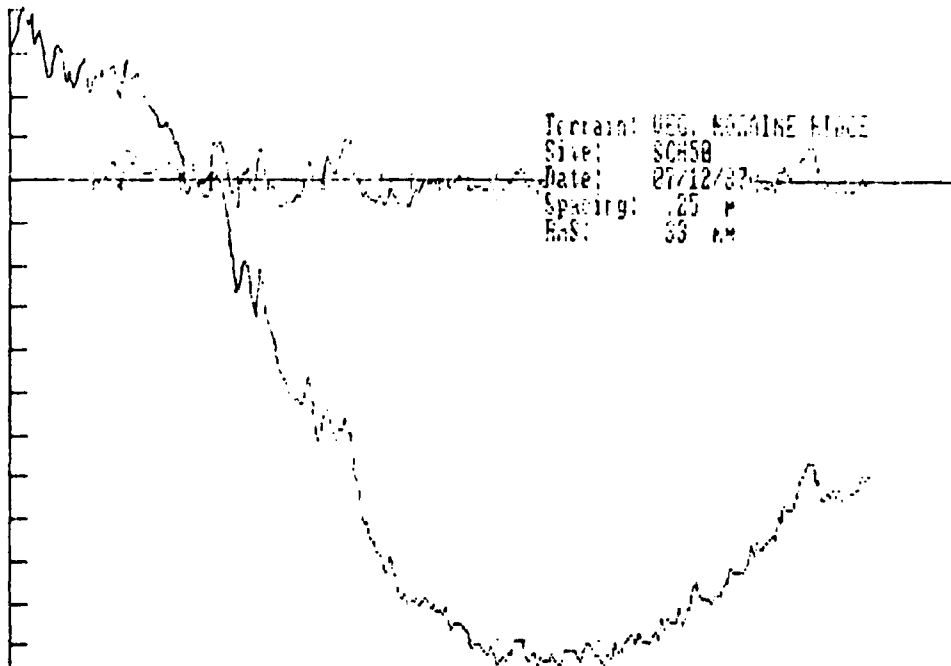


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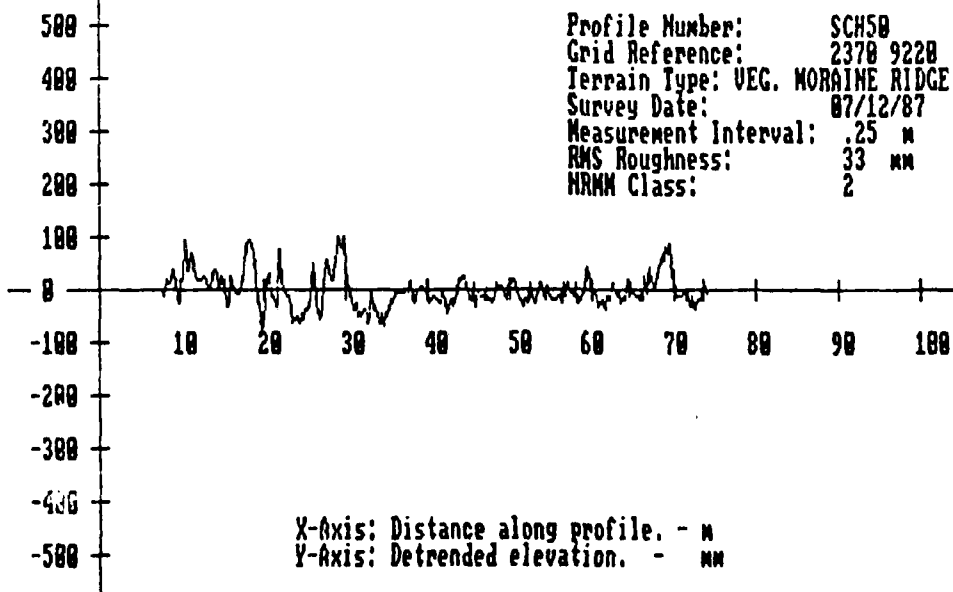
UNCLASSIFIED

/A-51

(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

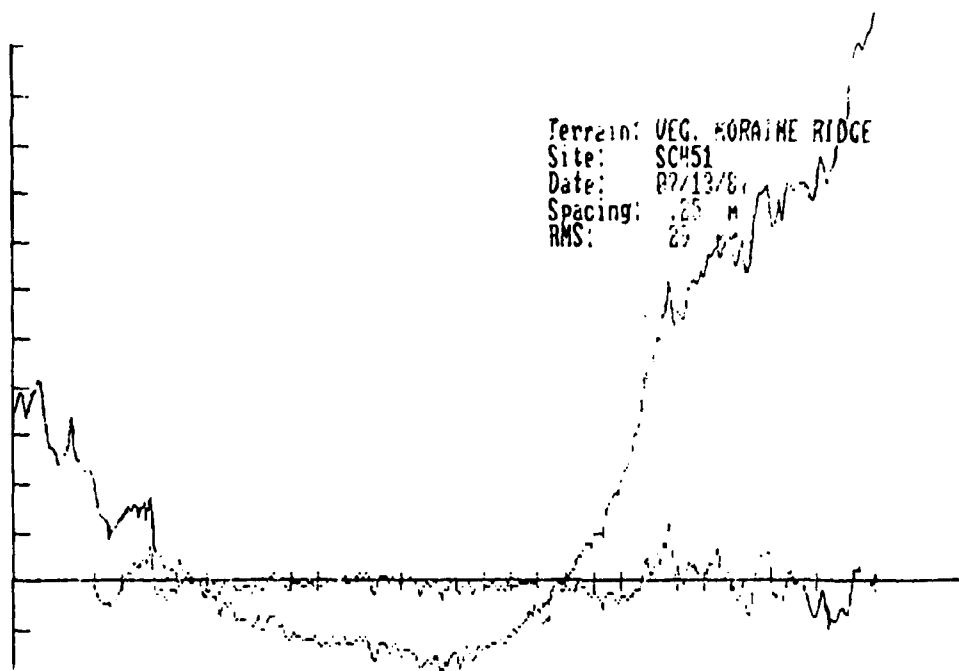


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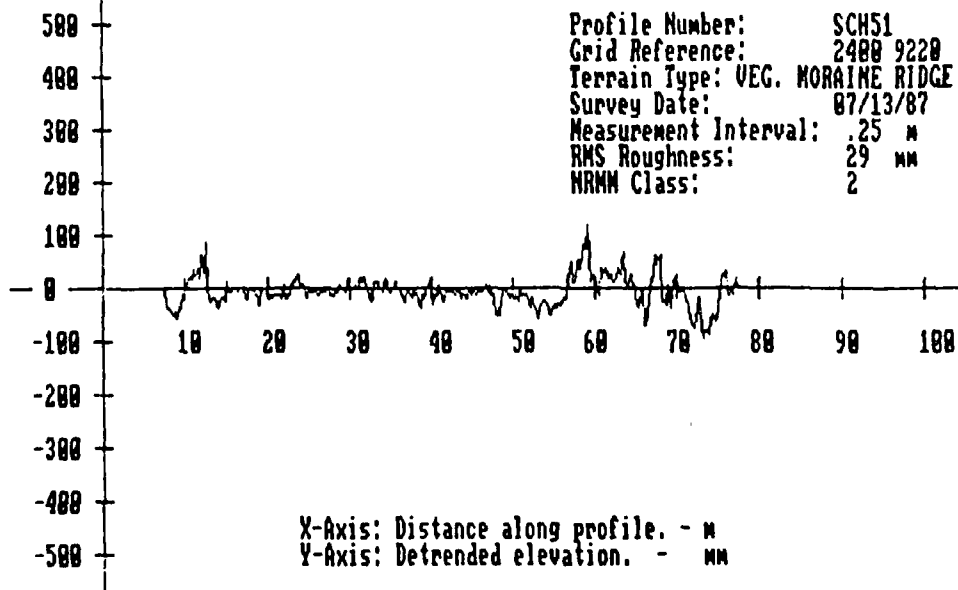
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(Raw Data)



Surface Profile - SCHEFFERVILLE Transect
(Detrended)

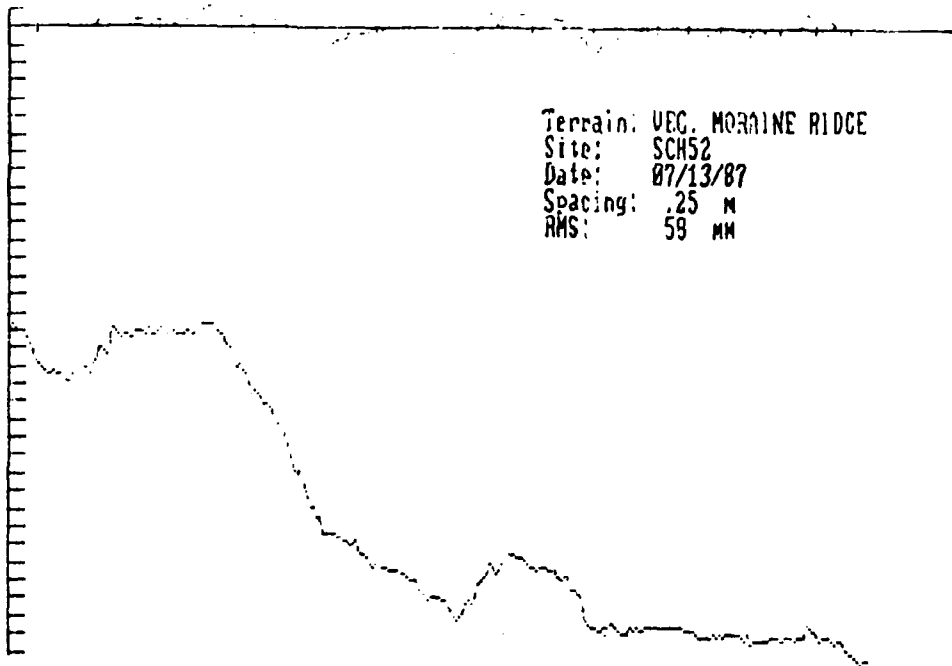


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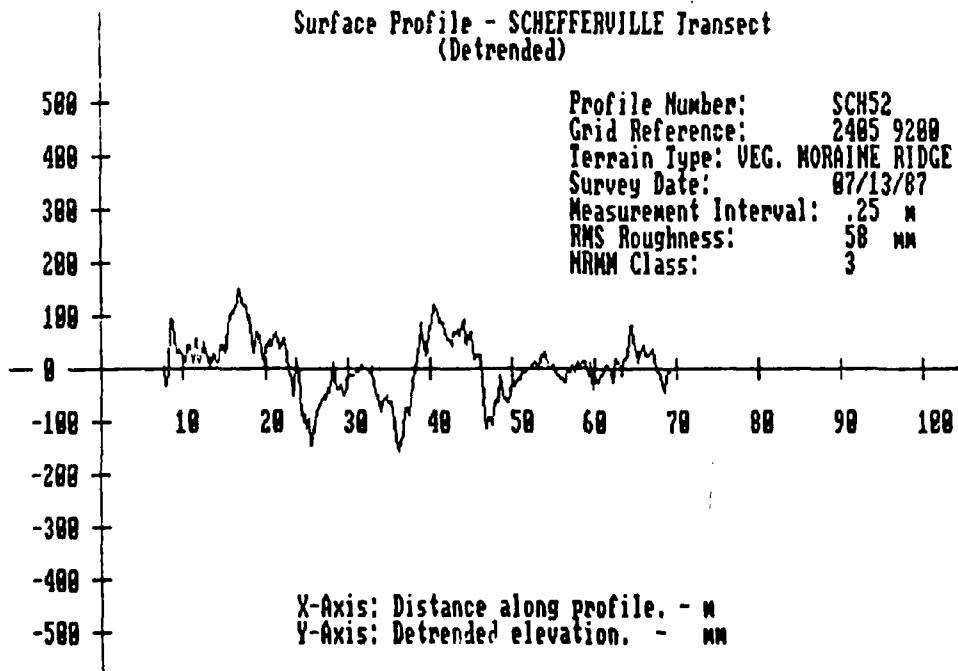
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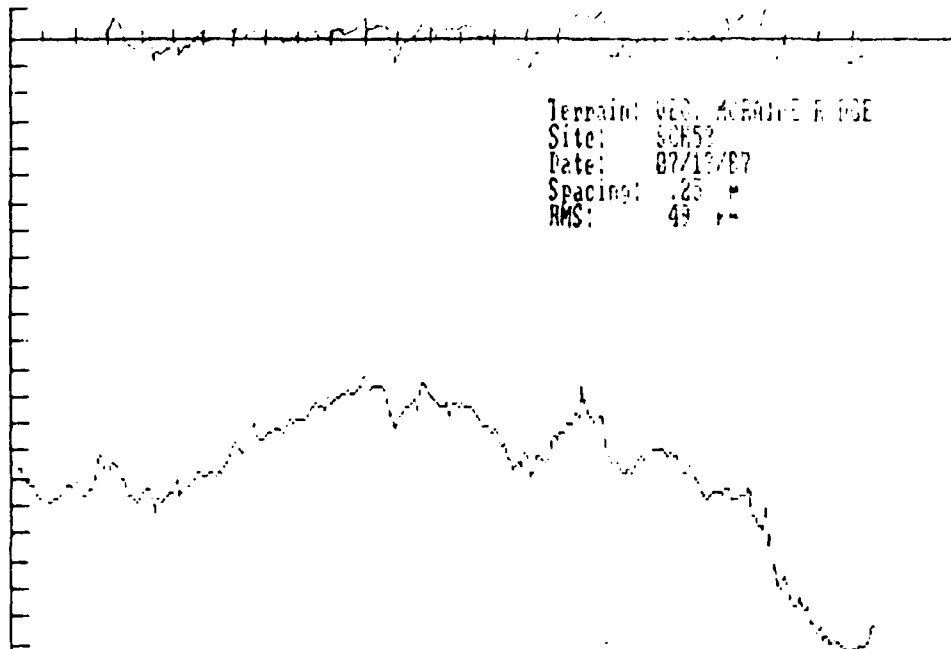
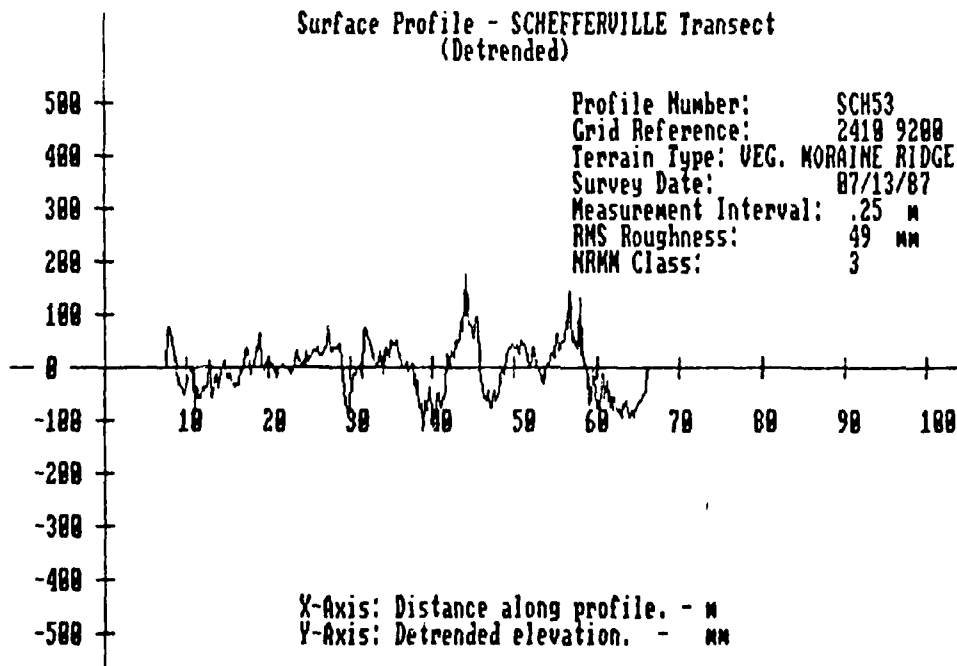


Surface Profile - SCHEFFERVILLE Transect
(Detrended)



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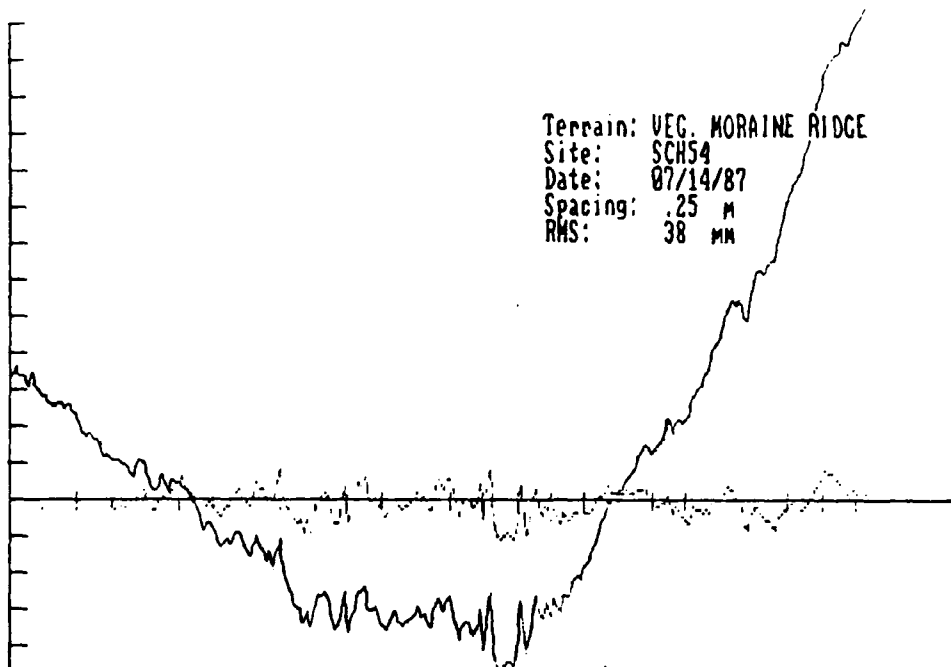
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Surface Profile - SCHEFFERVILLE Transect
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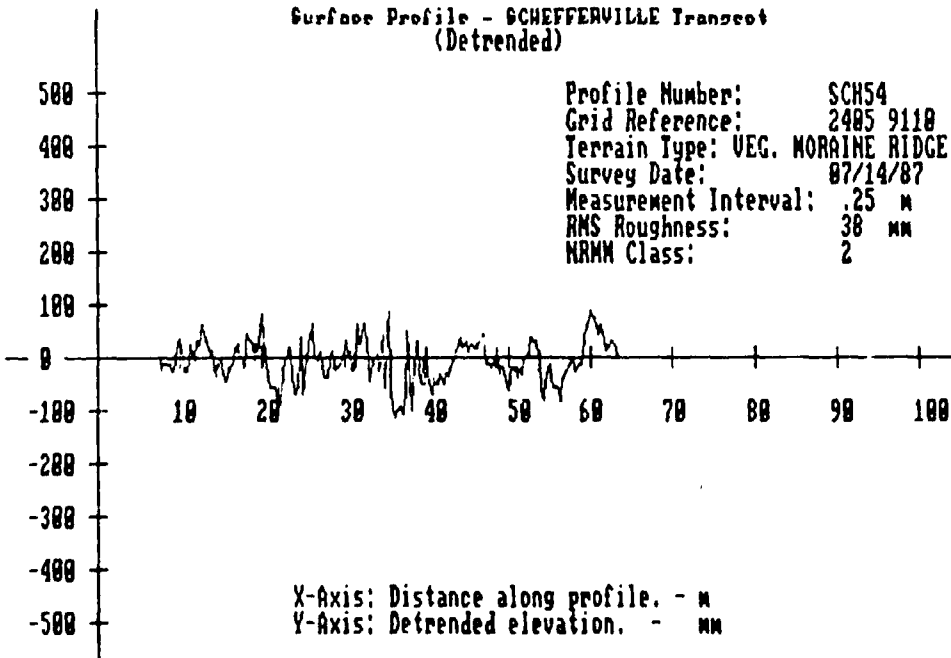
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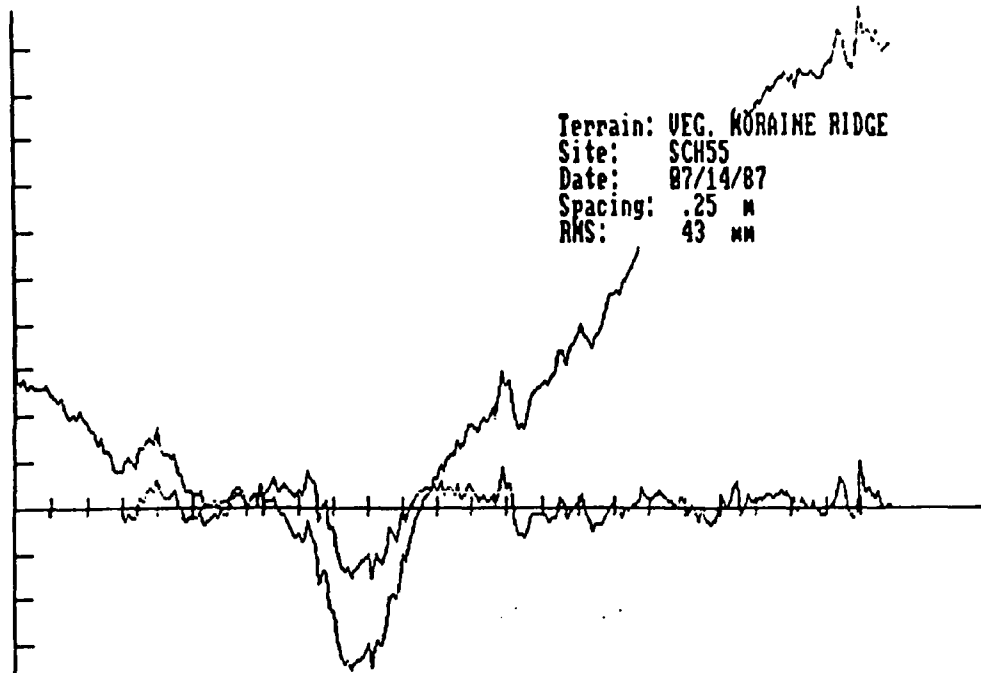
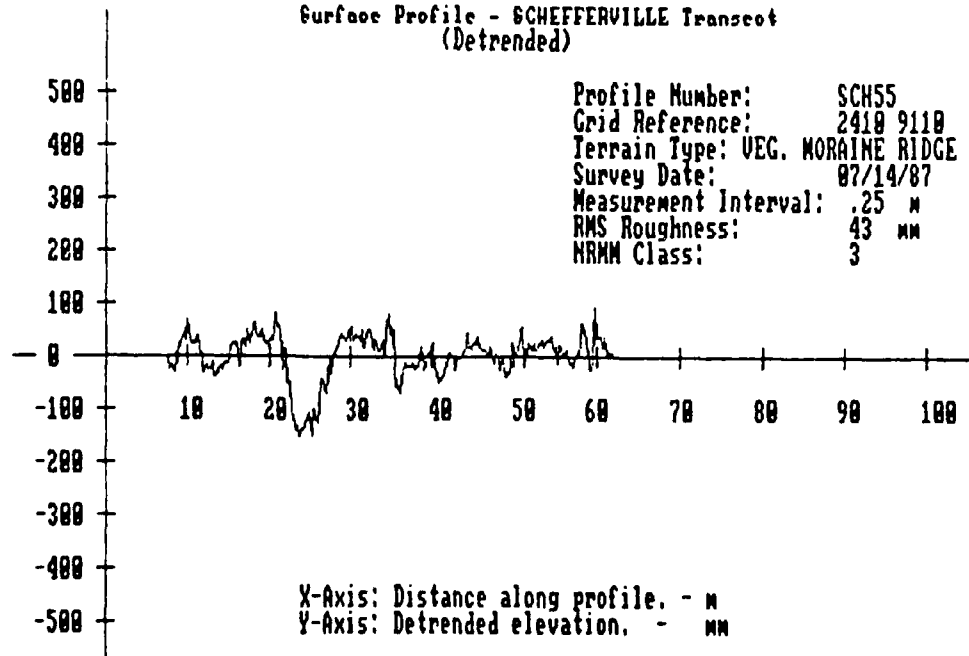


Surface Profile - SCHEFFERVILLE Transect
(Detrended)

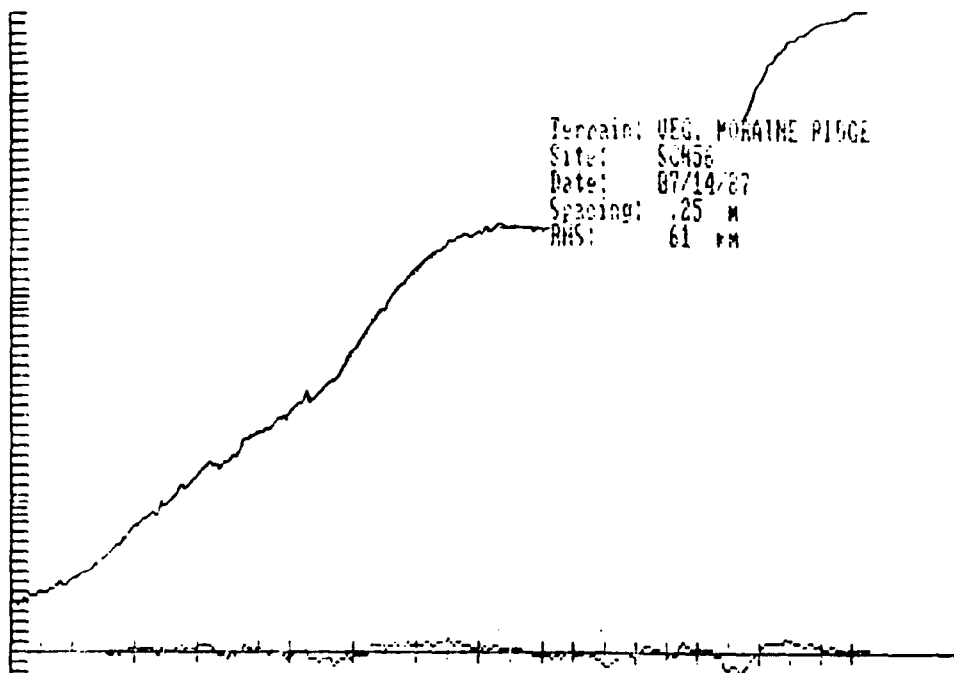
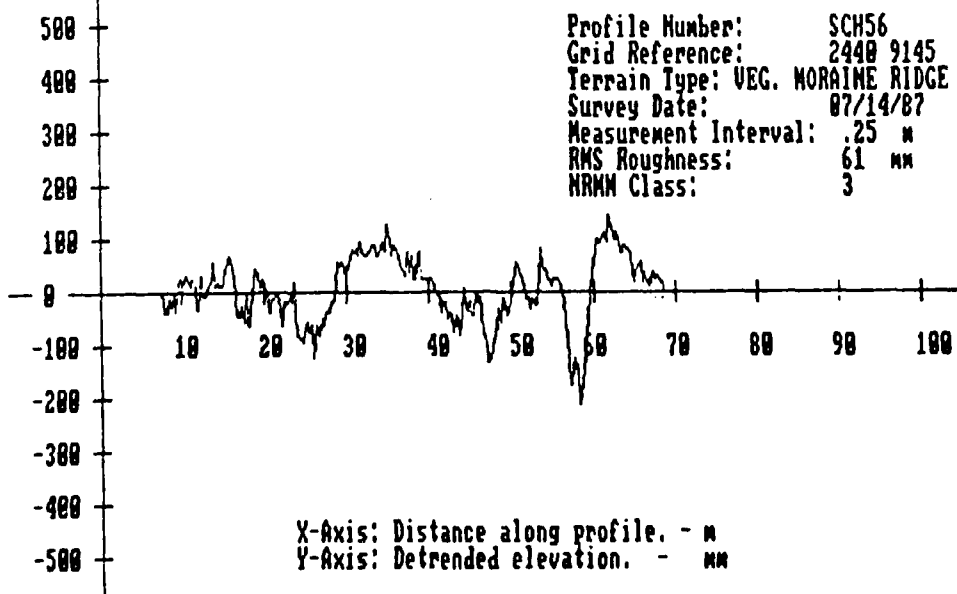


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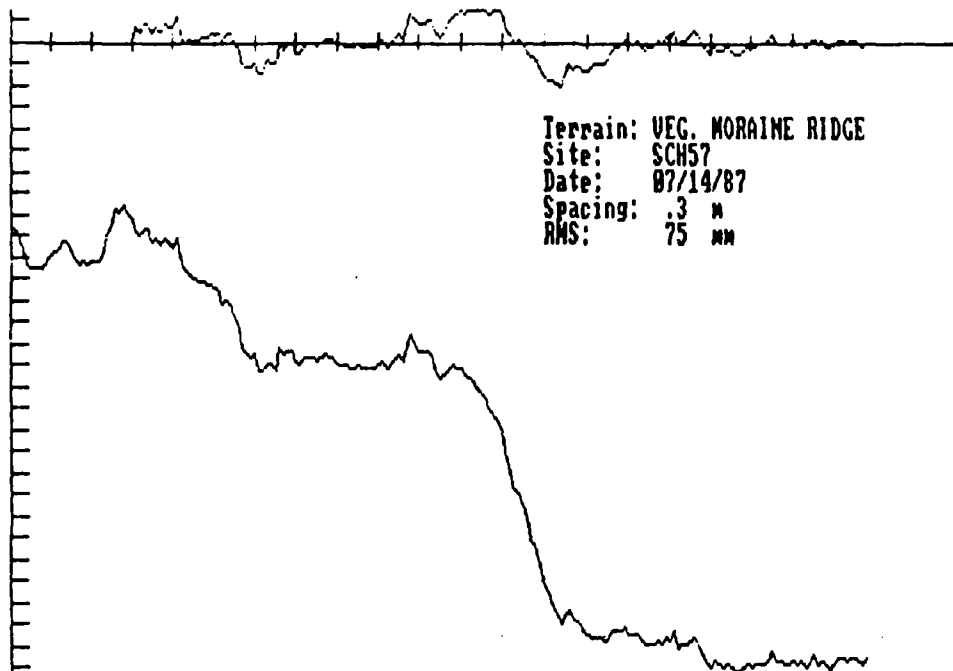
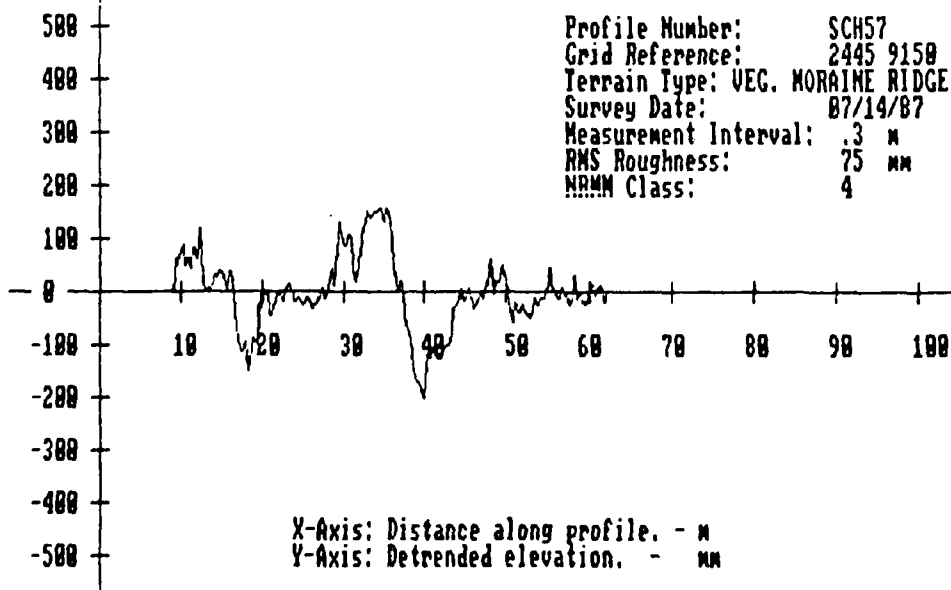
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Surface Profile - SCHEFFERVILLE Transect
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Surface Profile - SCHEFFERVILLE Transect
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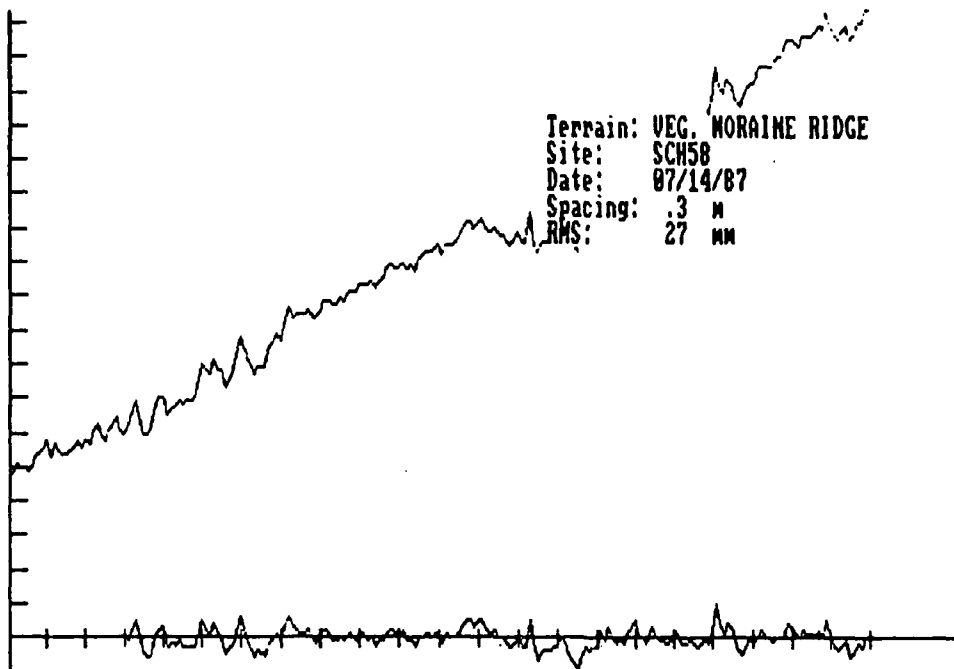
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Surface Profile - SCHEFFERVILLE Transect
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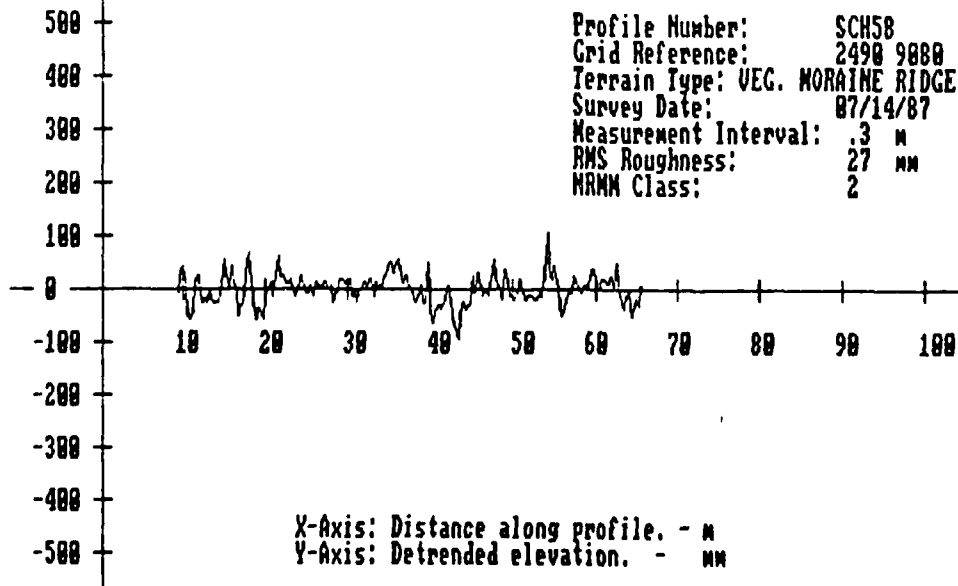
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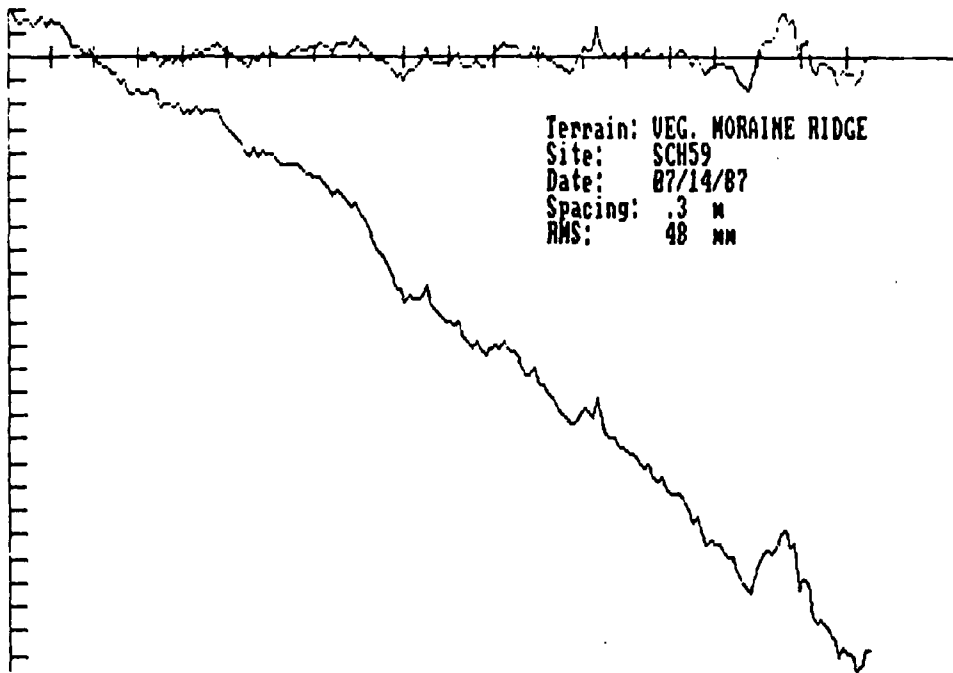
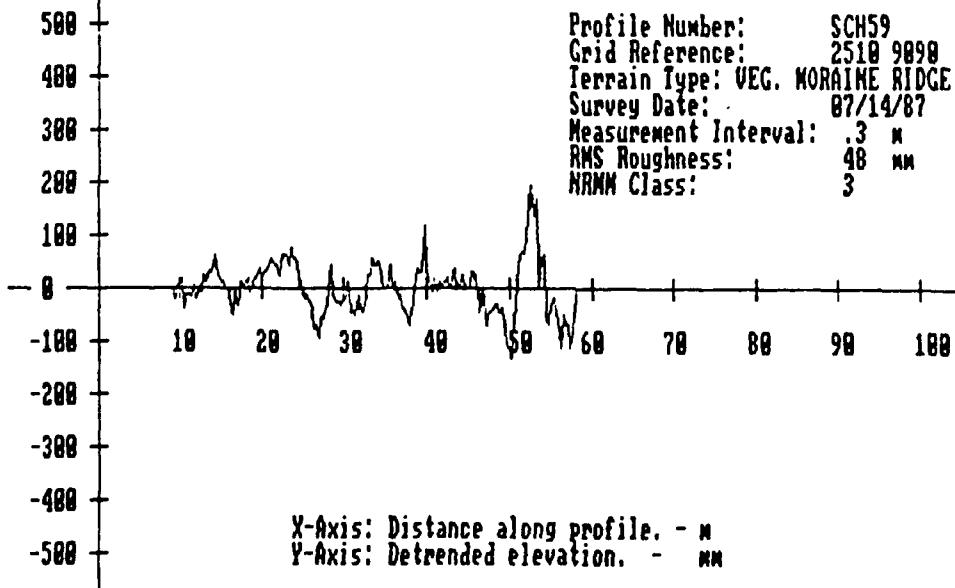


Surface Profile - SCHEFFERVILLE Transect
(Detrended)

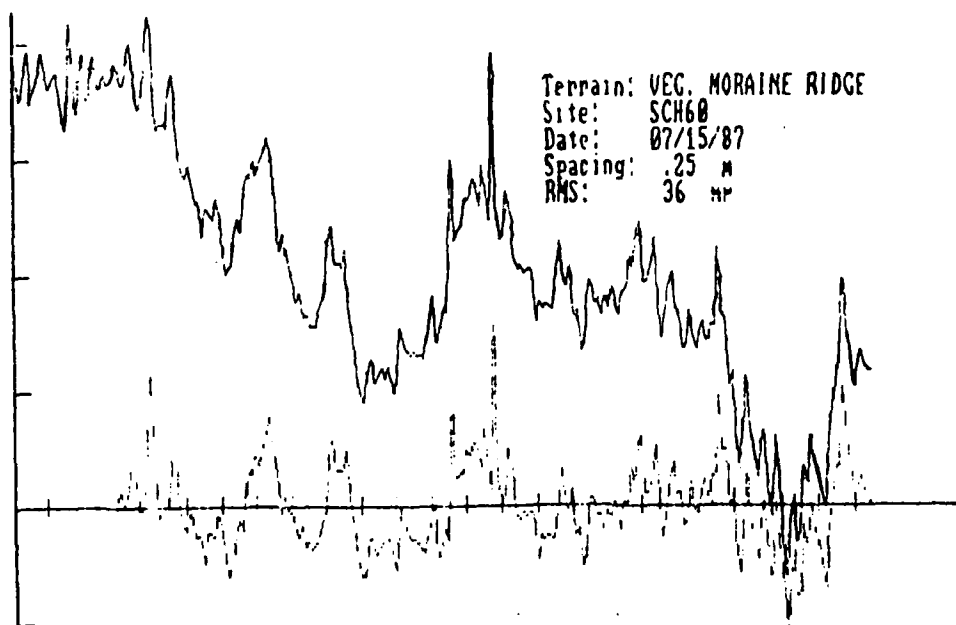
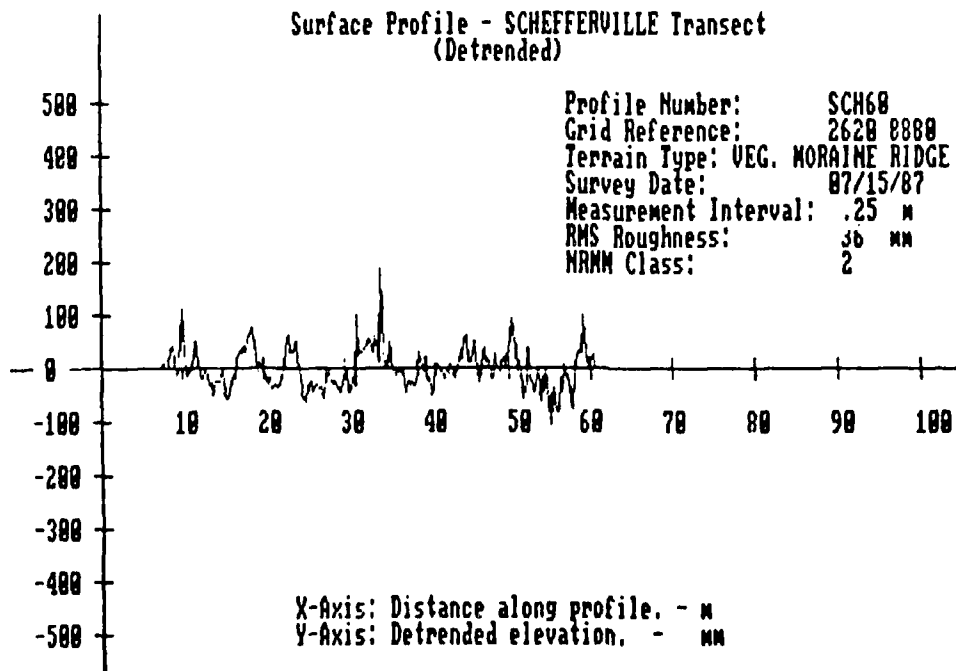


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Surface Profile - SCHEFFERVILLE Transect
(Detrended)

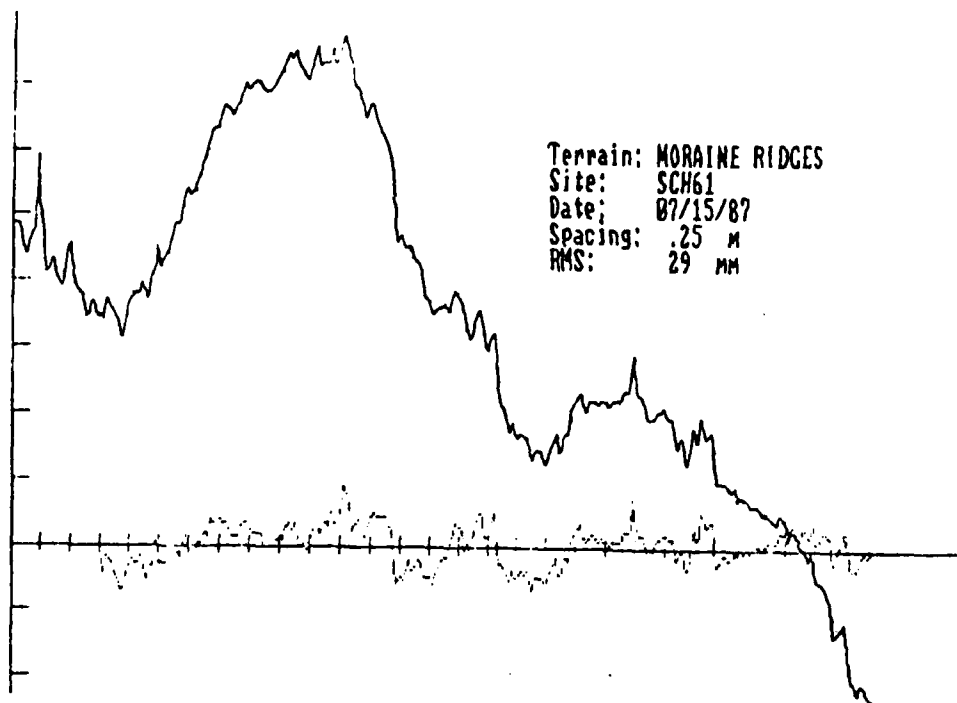
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Surface Profile - SCHEFFERVILLE Transect
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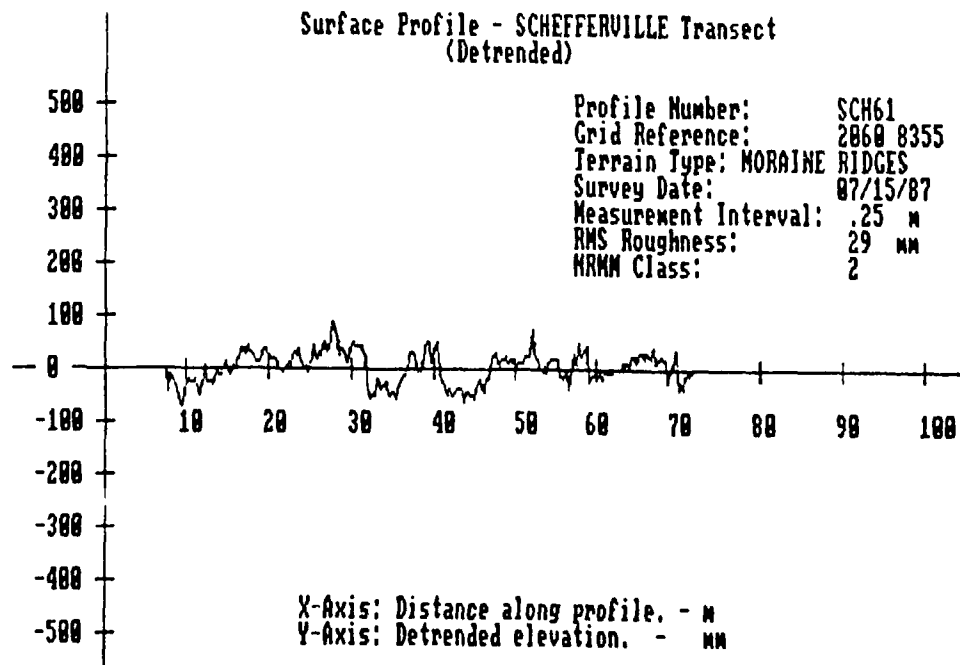
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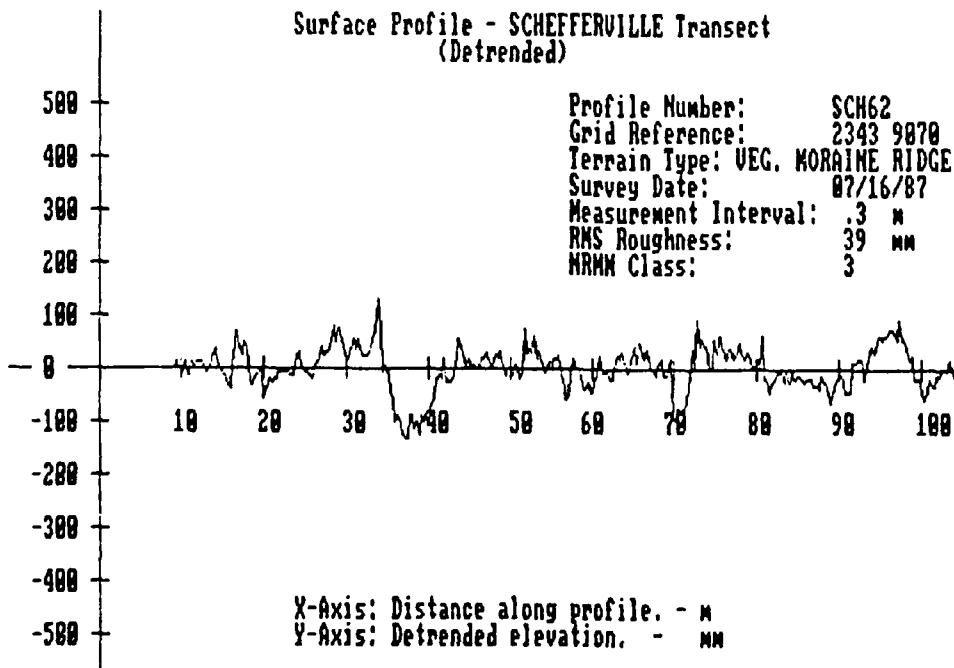
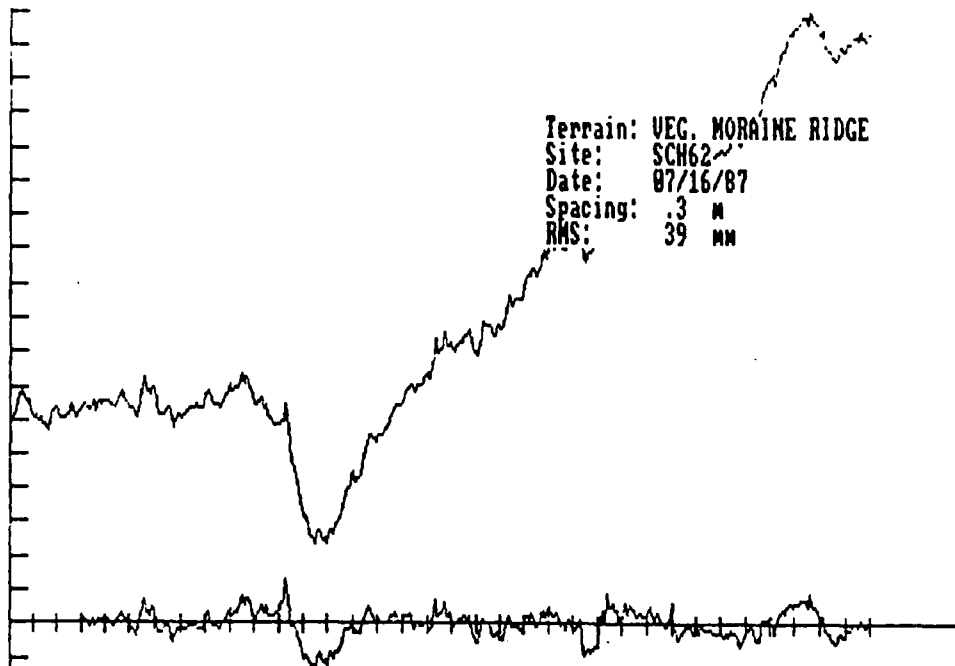


Surface Profile - SCHEFFERVILLE Transect
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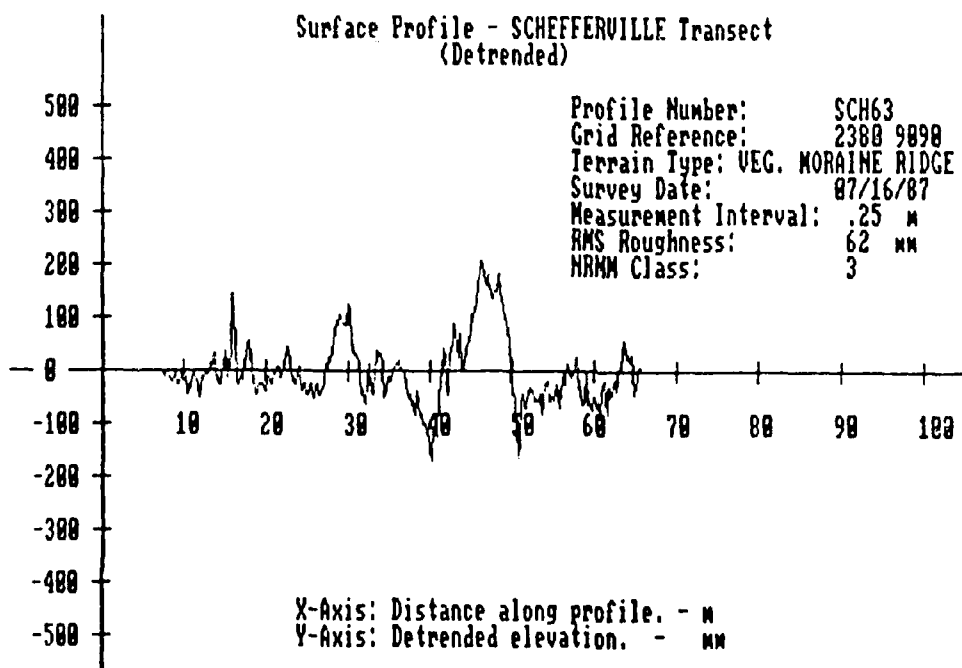
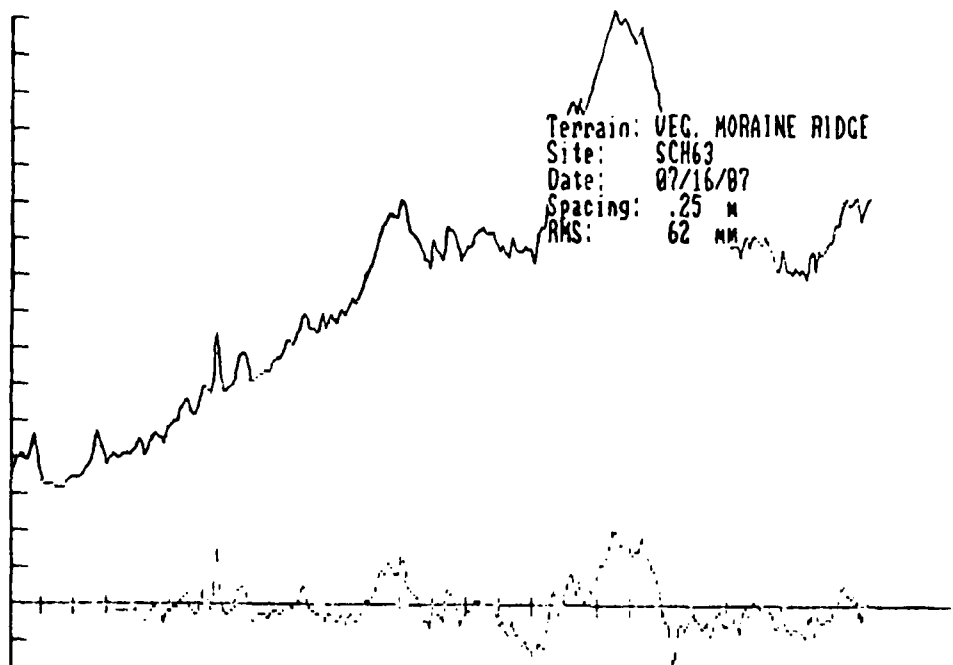


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13. ABSTRACT <p>There are two transects, Schefferville and Petawawa, in Canada which have been used to generate terrain surface roughness data for input into mathematical models such as the NATO Reference Mobility Model.</p> <p>The Schefferville data was collected during the summer of 1987 and this report deals with its analysis.</p> <p>The surface of this transect is predominantly a glacial moraine deposit with outcropping bedrock ridges.</p> <p>The analysis showed that the terrain at Schefferville was generally much rougher than Petawawa and that within the transect five separate surface roughness class types exist as opposed to three at Petawawa.</p>			

KEY WORDS

surface roughness
 geomorphology
 Sub-Arctic
 moraine

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